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PROCEEDINGS

— OF THE —

Western Gas Association

Fifteenth Annual Meeting,

Detroit, Mich.,

1892.

Sixteenth Annual Meeting,

Chicago, Ills.,

1893.

Seventeenth Annual Meeting,

Cleveland, Ohio,

1894.

Eighteenth Annual Meeting,

Pittsburgh, Pa.,

1895.

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PROCEEDINGS

OF THE

WESTERN GAS ASSOCIATION

FIFTEENTH ANNUAL MEETING,

HELD AT

DETROIT, MICH.,

May 18 and 19, 1892.

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1891-1892.

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PROCEEDINGS
— OF THE —
WESTERN GAS ASSOCIATION.

FIFTEENTH ANNUAL MEETING,
— HELD AT —
ARMORY HALL, DETROIT, MICH.,
May 18th and 19th, 1892.

FIRST DAY—MORNING SESSION.

The meeting was called to order by the President, Mr. E. G. Cowdery, of Milwaukee, Wis., at 10 A.M. of Wednesday, May 18. The Secretary, Mr. A. W. Littleton, of Quincy, Ill., recorded.

MAYOR PINGREE'S WELCOME.

THE PRESIDENT introduced the Honorable Mr. H. S. Pingree, Mayor of Detroit, who welcomed the Association in the following words:

Mr. President and Gentlemen of the Convention: I am exceedingly sorry we could not have furnished you with a better morning than this; but, notwithstanding the weather, nothing could give me greater pleasure than to welcome to our city any body of manufacturers. Certainly you are manufacturers—not only manufacturers, but producers of one of the most wonderful comforts of life, comforts that no city can do without. Think of a city without light, without heat, without the comforts of gas! I had been out of town for the last two weeks and would not have been with you this morning had I not, in reading a morning paper, happened to see a notice of your gathering here in our city and remembered the promise I had given Colonel Croul to be here and meet you. He said he would give me all the "points" necessary about gas—of course we all know that he is not only able but willing to do that at any time; but, gentlemen, I failed to meet him, and my "points" about gas, therefore, are somewhat limited. However, I do realize the fact that hardly anyone can live comfortably without gas in this Nineteenth Century. I was at a banquet last night where there was too much "Nineteenth Century gas," I assure you, and it kept me up until quite late in the night. While eating breakfast at the hotel this morning a gentleman said to me, "I am going to leave this town; I am not going to stop here." I asked him, "Why; what's the matter with Detroit?" "Well," he replied, "you fellows here are robbers; you are even stealing our gas." I found out afterward that he came from Toledo. So, you see, the last thing at night and the first thing in the morning seems to be gas.

I think, gentlemen, you have a great field before you in Detroit. While I am not a judge of your business or in any way connected with it, yet I am satisfied that in ten years Detroit will be using a great deal more illuminating gas than it is to-day. (Applause.) There is a great field, from my way of looking at it. It gives me a great deal of pleasure, I assure you, gentlemen, to welcome such a representative body of men to Detroit. Your President spoke about apologizing for the weather. The only thing I can say in extenuation of our weather is that for the last two weeks I found exactly the same kind of weather in Philadelphia and New York, but I hope we will have some better weather before you go away. Your friends here will entertain you, and I feel sure you will leave here so impressed with the beauties of our city and the generosity of our citizens that you will want to come here again. (Applause.)

ADDRESS OF THE PRESIDENT.

THE PRESIDENT then read the following address:

Gentlemen and Fellow Members of the Western Gas Association: We are assembled again in annual convention for the fifteenth time. In opening this meeting it is with pleasure I can do so in so beautiful a city, and one so well adapted to the entertainment of a large company convened both for business and pleasure.

In preparing this address it was not so much my intention to advance new questions as to call your attention to a few subjects which we have discussed in previous meetings, but whose importance seemed to entitle them to a further consideration.

Fourteen years ago, in September, 1878, this Association was organized, with 29 charter members; since that time there have been added, of all classes of membership, 410, the greatest number—51—being added in each of the years 1888 and 1890, and the smallest number—8—in 1882. During the same time there have been dropped, for various reasons, 160; so, at this date, we have of all classes of membership, 280 members.

The purpose of the Association was the gathering periodically of those engaged in engineering the methods of manufacture and distribution of gas, thus giving them the opportunity to make such comparisons of their methods and ideas as to materially lower the cost of production as well as to improve the service, making it possible thereby to cheapen the cost to the consumer, and so extend the use of gas until it should be recognized as a necessity in every household. How well Gas Associations have accomplished this purpose, the standing of the business at the present time shows.

At the date of organization of the first of the Associations, the ruling price of gas throughout our country was from $3 to $5 per 1,000 feet; now the aim of all is to sell gas at $1 per 1,000 feet, many having reached the period making it possible. Then gas was a luxury, and used extensively only in our larger cities; now it is a commodity, nearly every city or town of 3,000 population and upwards having its gas works.

Without the resultant benefit of Associations, and the influence they have had over members and the companies represented, I venture to say gas light would have been largely superseded by electricity.

That nearly all companies recognize the importance of the Association, no one doubts; still many are backward in sending their representatives. From such we would ask consideration and the careful weighing of the advantages against such reasons as they may hold for keeping their engineers from mingling with those whose lines of thought and whose efforts are devoted to solving the same questions.

While the great benefit and usefulness of our Association is acknowledged by everyone, all must concede there is much room for improvement. To my own mind, toward accomplishing this end, some plan must be adopted to bring out a freer expression of the practical results of our operations.

I believe the Association would be successful that would hold two meetings annually; one for the consideration of scientific subjects, with general attendance and the accompanying social features, and one with closed doors for the consideration of such subjects as a practical business meeting would develop.

I risk being censured for again referring to that "chestnut"—the entertainment at Association meetings. Improvement is our motto, and surely it would be in this line if resolutions were adopted so changing our practices that the gas companies or others in the cities we see fit to favor with our presence, should in no wise feel obligated to give us expensive entertainment. It is useless to declare we will not accept "banquets;" for we all know the weakness of mankind to accept that which is good, and which some other man's money pays for.

The method I would propose would be that, in selecting the city in which we expect to hold our annual meeting, we select the one which meets with favor from the greatest number, and the Association declare its purpose to so hold its meetings without having asked the approval of the gas company or others doing business in the city selected. When selection has been made in this manner, and without invitation, it would not seem obligatory upon anyone but the committee of arrangements to supply entertainment. Should it be offered, however without seeking, we would all be too courteous to refuse it.

In the same connection I would suggest the advisability of the consideration of a change in our by-laws. The date of our annual meeting being fixed, and the place of meeting selected a year in advance, it frequently happens that other meetings are being held at the same time, or that the climatic differences or other considerations make it inexpedient to hold the meeting at the time or in the place selected. The by-laws should be so changed as to make it possible for the Board of Directors, by a majority vote of the full Board, to change the time and place of meeting for the year such Board is elected to such other time and place as to them seem to be for the best interests of the Association.

Among those subjects which we have repeatedly heard discussed, but which still receives its share of our thought and consideration, is Municipal Control.

Considerable has been written upon this subject, and it is not for me to do more than express an individual opinion, after hearing the discussions and scanning the literature produced to this time, and considering it together with what experience and observation have taught me. Among thinking men who are best acquainted with our form of government and free suffrage, and who are either wholly unacquainted or are thoroughly acquainted with our business, I think the opinion predominates that the municipality cannot control successfully the gas supply or any other public service which is not universally used and which is not an absolute necessity.

Some, whose capacity for considering such a matter we would not question, but whose knowledge of the gas business is limited, are misled into taking the opposite view. Such men do not tell us why the poor taxpayer who does not use gas should pay, through his taxes, to help sustain a business which cannot from the profit it makes sustain itself. If such profit is made that the business is self-sustaining and pays interest to the city on the investment, the price charged will not be less than that of a private company properly protected and controlled by legislation.

Prof. Edward Bemis, in his article so ably written and lately published, acknowledges that municipalities and all they control suffer from the work of the politician; but he claims this is offset by the selfishness of private corporations and the stock-watering system.

It is true this latter is one of the evils we have to contend with, but it is practiced by comparatively few of our gas companies. Some of these are more or less justified in their practices, considering their investment of hundreds of thousands, and perhaps millions of dollars, is wholly unprotected from the methods employed by the professional politicians in pouncing upon corporations, squeezing them to any extent to create public favor. At any time not only their future profits but their capital may be wiped out by the action of such politicians.

Those who are acquainted with the intricacies of our business, and who are posted as to the practices of the average politician, know that the public is much better served by private corporations in its gas supply than by those works under municipal control.

There has been sufficient competition during the past twenty years to drive every gas company into finding cheaper methods and ways to improve its product. Had the municipalities owned our plants during this time they would not have found the way to accomplish these ends, because they would not have been driven to it. Are not the older municipal works of this country the last to make the improvements?

Comparisons are often made with the cities of Europe whose gas plants are owned by the municipality. Bear in mind, their forms of government and suffrage are different from ours, and generally better adapted to the success of any public service under municipal control.

The solving of the question, how to supply the public with the cheapest gas light, does not lie in municipal ownership—at least not until our free suffrage is abandoned. I think the solving of this question lies in leaving the gas supply of our cities in the hands of private companies which should be given a monopoly and otherwise protected by legislation.

To avoid the possibility of dishonesty, or the taking advantage of the enjoyment of a monopoly, such companies must necessarily be more or less subject to legislative control.

Electric competion has so far resulted principally in stimulating the gas business. Arc light has quite generally displaced the gas lamp for street illumination, and eventually will, doubtless, monopolize that portion of the service.

Although to this extent we have been obliged to give way to this other illuminant, we all agree the result has been the general education of the people to require more light. Incandescent lighting plants have multiplied on every hand until nearly every city is supplied with its requirements in this direction. The result of so general an introduction of electricity has been in some cases to check temporarily the growth in the consumption of gas; but as a rule it has not been able to compete with gas where the latter is sold for $1.50 to $2 per 1,000 feet. In some cases where incandescent light was introduced with unusual zeal, or where the conditions of gas supply put gas in disrepute, electricity gained much headway; and in some cities it is yet a formidable competitor. On the other hand, there are many places where it has had to struggle to gain a foothold. It is well understood that the incandescent electric plants of this country are not making a profit over the expense of maintenance. It is generally acknowledged that the cost of production and the price at which it is furnished cannot be materially reduced until the steam boiler and engine are discarded in its production. We are told that as its use for power develops and the patents on the bulbs expire we had better look out.

No one knows better than the gas engineer what the reduction of fixed charges means; but, altogether, we think the relation between incandescent electric light and gas light will not materially change until the production of electricity can be economically accomplished without the aid of power.

The term fuel gas has so wide a range of application that in order to be more clearly understood I will apply it only to uncarbureted or partially carbureted gas. No great strides towards success have been made during the past year in the distribution of fuel gas for general use. Isolated plants for special purposes are without doubt successful, and such purposes will develop for its use from time to time until its place is firmly established.

Whether a manufactured gas for general distribution be a non-illuminating or illuminating, a coal gas or a water gas, or a mixture of gases, it has been clearly proven that none can at the present time be so cheaply made and distributed as to come within the reach of the community for general heating purposes.

For intermittent heating, for cooking and for some special purposes, a fuel gas, or gaseous fuel, is worth a fair price, and nearly in proportion to the heat units contained, as shown by analysis.

That there is enough business for a company to supply gas for such purposes only, there can be no doubt, provided its use for such purposes becomes general; but to make it general it must be sold for a remarkably low price, and such price can only be attained by practicing every economy, not only in the production but in the first investment.

It should be clear to every one that the company that can supply its fuel gas and illuminating gas through the same system of mains has the advantage over that requiring two systems to do the same work.

It remains, then, for each to determine in his particular locality which gas can be manufactured and distributed at the lowest price in proportion to its value, and derive the greatest profit; provided we concede that the use of fuel gas for illuminating purposes, by means of incandescent burners, gives satisfaction, which I think has not so far been sufficiently proven.

Believing thoroughly in a single system of mains, and that a good quality of illuminating gas for all uses could be distributed throughout the city with the greatest advantage both to the consumer and the investor, the Company with which I am associated adopted this method of supplying the demand for fuel gas. Since Jan. 1st, 1891, we have sold gas for illuminating at $1 and for fuel at 80 cents per 1,000 feet.

The result has been a wide advertisement of the fact that gas could be used advantageously for cooking and for special purposes. New uses were developed for gas, such as roasting coffee, frying doughnuts in the bakeries, drying tobacco on a large scale, heating rivets for the power riveter and melting metal for the electrotype works; and it is at present almost exclusively used in our candy factories for boiling what is known as the soft-boiled candies. We have created an extensive demand among the laboring classes for gas, both for fuel and for light.

The increase in consumption in 1891 was the greatest the Company ever experienced. The increase in the number of consumers was 50 per cent. larger than any previous year, and the indications so far the present season are that the increase will be nearly 100 per cent. over last year and 300 per cent. over any previous years. For all this increase we are largely indebted to the low price of fuel gas.

Many interesting points are brought out which can only be learned by metering gas used for fuel separately. About 2,500 fuel meters were set during the year, the average monthly registration of which was 3,000 feet, until November, when it dropped to about 2,500 feet, and in December to 2,000 feet, showing quite conclusively, I think, that when the gas range is once in a house it is used throughout the year.

Gas for fuel for special purposes is a success, but artificial gas for fuel to displace coal in the household for all purposes will not be a success until the discovery of a method of manufacture which is not known at the present time. A paper has been provided upon this subject by Mr. K. M. Mitchell of St. Joseph, Mo., which will undoubtedly bring out facts of much interest to all who are seeking to supply gas for fuel.

In reviewing the general subject of gas we should not be so enthused with the newer methods as to neglect the old reliable coal gas. To one who has become accustomed to water gas, or its various mixtures with coal gas, it is surprising, as he comes across a clean, pure coal gas, how readily he will pronounce it "good gas." Coal gas, when pure and with no mixture of air, does merit the distinction of being "good." Though somewhat more red in color than water gas, it has a larger flame area and impresses one with the softness and mellowness of its appearance. Whether one should choose to manufacture coal gas or water gas depends upon a great variety of considerations.

Generally, where coal gas is settled upon, it is because of the possibility of manufacturing cheaply in the particular locality under consideration. In such places it is cheap, either because of the low price of coal or the high returns for residuals.

The large amount of labor required has been one of the strongest arguments against the maufacture of coal gas. To overcome this obstacle, the inventive genius of man has been brought into play to devise methods and machinery to increase the amount of gas made per man, and to so simplify the work that the most ordinary labor would meet the requirements. The result of the effort in this direction, as well as to make other savings, has been regenerative benches, half-depth benches, firing the same with various materials, oxide purification, which has been followed by revivification in same vessels, purifying in closed vessels, handling of all materials by machinery, charging and drawing retorts by machinery or by gravitation. In fact, the modern coal gas works of to-day, if of sufficient size, would not handle any of the material used in production or residuals made, with manual labor—machinery would be universally used.

With so much accomplished, and with a great many of us having reached the point where the residuals paid the coal bill, it is with regret we have to chronicle the fact that the value of coal tar has experienced a rapid and excessive decline. Our question-box may reveal some of the reasons, and we hope may suggest a remedy.

Two of the papers to be presented to this meeting treat of subjects more particularly interesting to those manufacturing coal gas—those supplied by Messrs. Bredel and Odiorne.

There is much to be learned from these papers, and it is to be hoped all will make an extra effort to be present when they are read, and listen to and take part in the discussion sure to follow.

Many new processes are brought out and come to our notice, from time to time, by the extraordinary claims of the inventors. The last year has not passed without the usual number of these productions. We had expected a paper reviewing those new processes brought most prominently before us within the past year. We were disappointed in this, and time did not permit me to make such a careful study of them as to allow me to comment on them. It is a good subject for some writer, and would prove useful to us to have the strong and weak points of each brought out in open discussion.

All may content themselves with the reflection that no one will make a mistake who builds after any of the well-known reputable water gas processes, or the still older coal gas.

At no time in the history of the business has it seemed so necessary to bring water gas to the front, to have it introduced into every works, either to be used exclusively or in conjunction with coal gas, as at the present time.

It is no longer a question of cost of manufacture that should influence us. Competition necessitates increasing the illuminating value of gas beyond the present possibilities of coal gas. Twenty-five candle power gas and upwards is, or should be, the aim of all of us. Every additional candle power of illuminating value we can give to gas places it that much farther in advance of the competition with incandescent electric light. A 32-candle power electric light costs nearly twice as much as one of 16-candle power, while a 32-candle power gas light costs but little in excess of one of half the illuminating value.

I repeat, we do not need to fear this competition; but at the same time it should be understood we are alive to the requirements of the day and that we are going to improve where improvement is possible. A higher illuminating value is the order of the day, and water gas seems to be the cheapest and most available means toward that end at the present time.

To those who are using water gas extensively, it is at times a serious question whether its production should be carried on with the use of crude oil or with naphtha, the latter selling at a higher price per gallon, but being a cleaner, purer oil. It seemed that no one would be better able to enlighten us upon this question than the gentlemanly representative of that greatest of all monopolies, the Standard Oil Company, who for several years has been meeting with us, and whom we have all grown to respect and recognize as one of us, Mr. C. M. Higgins.

Among all the subjects which have been presented to us at various times, there is one which should receive more attention than has been given it; that is, the methods and policy in conducting the affairs of the gas office.

The merchant in conducting his business makes an effort to find customers, and he strives by honest dealing and fair treatment to retain them. He leaves no stone unturned to humor their eccentricities and gain their confidence. There is no reason why different means should be employed in conducting the affairs of the gas office. If you want to sell gas, present its advantages to the people, show them an effort is being made to get the consumers, and that an equal effort will be made to retain them and to remedy all causes for complaint.

Though the gas business is generally conducted as a monopoly, there is no reason why that fact should be paraded before every consumer and thus antagonize him; rather seek by our methods to disguise the fact, and make the consumer forget the existence of the word " monopoly."

It is true many of our companies do conduct their business after these modern lines; but there are still some who seem unable or indisposed to see wherein their future success lies.

Bearing little perhaps upon this line of thought, but still upon the method of handling some of the details of the gas office, Mr. W. L. Brown, of Evanston, Ill., will present you a paper well worth the attention of every one.

None of us enjoy working so extensively as we do with material we know so little about. The formation of coal and the formation of petroleum as well has occupied the thought and been the means of a great amount of study of many.

Different opinions have been given us at different times and by various persons. Mr. A. E. Forstall, of Newark, N. J., will give us at this time the result of his researches in this study. We trust all will be glad of the opportunity to learn something of the mystery surrouding the formation of these products and will appreciate Mr. Forstall's effort.

Every gas engineer, whether he is given the distinction of being a " coal gas man " or a " water gas man," makes use of apparatus for the purpose of conveying necessary information to him of what he is accomplishing.

There are various forms of all kinds of apparatus; some are expensive and complicated, some are simple and inexpensive, some require time and a person educated in their use to handle, and some are quick to give results and can be manipulated by any one. The latter meet the requirements of the gas engineer; and, as the result of research in this direction, papers will be presented by Messrs. Chollar and Stedman, both of St. Louis.

Mr. Chollar has repeatedly presented papers upon "Photometry," and we all know how well he handles this subject. Mr. Stedman will present to you some new features and some new thoughts, and those in the habit of following their products through the laboratory will be especially interested in this paper.

The Society of Gas Lighting of New York has spent some time in preparing plans of uniform dimensions for the various sizes of cast iron specials for gas works and street main purposes. It seems to have been successful in settling upon dimensions, which will make the castings light, strong and cheap.

It is the purpose to get the several pipe manufacturers to make a set of patterns and furnish us the specials, as they do now the pipe. The uniformity of dimensions would be a great advantage to us, besides the probability of obtaining them cheaper than from our home foundries.

One of the pipe manufacturing companies has expressed to me its willingness to make a set of patterns designed to meet the requirements and views of the gas engineers. It might be well for this Association to have this table of dimensions presented to them for such action as it seems wise to take. As two years have been spent in its preparation, I earnestly hope it will be adopted, in its present condition, without further consideration.

It is scarcely necessary for me to say much concerning the World's Fair. Much has been published and the whole matter has been gone over so often, of how the various Associations appointed committees, how these committees met with failure in securing recognition from the World's Fair management, how the Gas Industry Council picked up the matter, and how they have been successful in securing recognition from the World's Fair management, to the extent of having been alloted space on which to erect an exhibition building, and how they have been successful in raising money with which to carry on the work.

We are all glad to have gas recognized in such an exhibition of the industries of our country, and in view of the fact that such an elaborate, expensive and complete exhibition of electricity is to be made, that many a visitor would go home with the idea that electricity was perfection, it seems necessary to offset such an opinion by displaying gas in all its advantages.

As the World's Fair management made no provision for a gas exhibit building, as manufacturers of gas apparatus would not undertake such a burden themselves, and as the gas company representatives thought an exhibition other than collectively would not accomplish the object, the only remaining thing was to shoulder the burden upon gas companies and manufacturers together and push it to success. If the object can be gained by a small contribution from each in proportion to his means, no doubt all will feel repaid for their contribution.

It is to be hoped that the work once started will be carried through to success and be made a credit to our industry.

Many among us to-day will feel keenly the absence of those who were accustomed to mingle with us, but who have gone from us to return no more. We shall to-day and in the future miss their voices, their company and their valued experience. We were wont to hail with enthusiasm the incoming of one, who always was present, although his afflicted condition would have caused one less in love with our Association to have remained away.

We ever welcomed the remarks of him who made the needs of the gas fraternity his life-study, and who was ever ready with advice, and by means of his cheerful ways and hopeful spirit, never failed to strengthen the faith of all in our industry.

May we be spared further affliction during the year to come, and when we meet again may our Chairman be able to announce that none of our members have passed from this life.

It is with deep sorrow we chronicle the death of these loved members:

Edwin M. Russell, died May 28, 1891.
G. A. Hyde, Jr., died June 11, 1891.
Edwin Lee Brown, died July 21, 1891.
Samuel Prichitt, died Sept. 21, 1891.
Geo. Shepard Page, died March 26, 1892.

COMMITTEE ON PRESIDENT'S ADDRESS.

Mr. Ramsdell—Mr. President, we have listened with a great deal of interest to your admirable address, and I move that it be referred to a suitable Committee for report at this meeting.

The motion was carried, and the address was referred to a Committee named by the President as follows: Geo. G. Ramsdell, Jas. Somerville and Walton Clark.

APPOINTMENT OF SPECIAL COMMITTEES.

The President then announced the following special committees:

On Applications for Membership—Irvin Butterworth, B. W. Perkins and W. B. Sellers.

On Examination of Books and Accounts of the Secretary and Treasurer—W. H. Odiorne, A. S. Miller and Jerome Penn.

On Nomination of Officers—Thomas G. Lansden, Fred. Egner, W. L. Brown and Wm. Tracy.

On Place of Next Meeting—B. E. Chollar, J. B. Howard, F. M. Doan, J. W. Dunbar and F. H. Shelton.

On Final Resolutions—E. H. Jenkins, C. W. Blodgett and E. G. Pratt.

On Memorials—John McIlhenny, R. H. Canby and H. C. Bolcom.

REPORT OF COMMITTEE ON WORLD'S FAIR.

The President—I think the report of the World's Fair Committee of this Association is ready for presentation.

Mr. Ramsdell read the report of the Committee as follows:

To the Western Gas Association—Gentlemen: Your Committee on World's Fair, appointed to represent this Association, as part of the General Committee representing all the Gas Associations, beg leave to submit the following report: This General Committee, organized with Mr. Harbison, President of the American Association, as Chairman, was made up of similar committees of other Associations, and instructed to act in conjunction with the General Committee. This Committee entered upon its work; but at the outset discovered very great obstacles lay in its path, and its work was all done under the most adverse and discouraging circumstances. It progressed, however, slowly, and accomplished some important steps. It was finally deemed wise to recommend that another committee be appointed to carry forward the work. This was made the subject of a report to the American Association, at its meeting in New York last October, coupled with the recommendation for the appointment of a new Committee. The old Committee was discharged and a new Committee (composed of manufacturers of gas apparatus) appointed at that meeting. This Committee at once entered upon its duties, the results of which have been given the gas fraternity through the columns of the Gas Journal. It was, however, unsuccessful in securing all that was desired. Under these circumstances a meeting was called in the city of New York, composed of a large number of representative men having the interest of the gas fraternity at heart, which resulted in the selection of a new Committee, or Council, of seven to assume and go forward with the work. The Chairman of your Committee was invited to join in this movement by signing the circular letter issued, and was also invited and took part in one of the general meetings held in the city of New York. The result of these meetings and various steps taken by the Council are familiar to you all. Your Committee believes the Council is representative in character and well equipped for the work it has in hand. Your Committee has been given to understand that, although there are at least two members of the Western Association in the Council, yet if the Association desires to have a special representative as a member of the Council, it can be done by designating at this meeting whom its representatives shall be. From the knowledge which your committee has, it believes that the Council is now doing all that can be done, and feels confident that the interests of the gas fraternity are being served as thoroughly and efficiently as is possible.

It is of paramount importance, in the judgment of your Committee, that the members of this Association should, without further delay, respond to the appeal made to them for subscriptions. The Council have, as you are doubtless aware, secured at least a favorable site and are in readiness to proceed with the contract for a suitable building, and such other matters as become necessary to decide previous to the beginning of operations. They are asked to decide matters involving large outlays of money, and it is not only difficult to do this, without having the amounts previously subscribed, but they could also plan and execute their work much more efficiently could they know beforehand about what amounts to count upon. Your Committee, therefore, recommends that the report of this Committee be accepted, that the Committee be discharged, and the Council, which are now performing the duties in its stead, be most heartily endorsed by this convention. We also recommend that the members of this Association who have not already subscribed, immediately upon their return to their various homes take this matter up promptly and send in to the proper officers at once their subscription.

Geo. G. Ramsdell, *Chairman;*
Walton Clark,
A. W. Littleton.

On motion of Mr. Jenkins, the report of the Committee was received and the recommendations adopted.

The President—This matter was talked over yesterday in the Board of Directors' meeting at some length, and we understand that Mr. Humphreys, of the Gas Industry Council, would like to make some explanation of the work of this Council before this Association. I presume this report and the discussion that will follow will take up some time, and we thought perhaps it would be a good plan to call a special session for this evening to consider the World's Fair matter only.

Mr. Shelton—There is nothing more important before the Western Gas Association to-day than the action it will take in regard to the World's Fair matter. The matter is at a critical point, and it needs the united support of the Association to make it really go. It seems to me the list of papers at this meeting is not very long, and I think that this matter had better be disposed of at once.

Capt. White—It will not take more than half an hour of our time to have Mr. Humphreys and other members of the Gas Industry Council present this important matter to the Association. As Mr. Shelton has said, certainly we have no more important business before us to-day than our action on this pressing subject. A very queer idea has entered the minds of some of the gas men of this country that somehow and in some way the seven gentlemen who have been selected to perform this onerous duty have private axes to grind, and that they individually will be benefited by it—how, I do not know. I certainly can gain not a penny, but certainly may lose many dollars by attending to this business! There is not a member of this Council honestly subject to such criticism, and when we come into the session and find hardly a word of encouragement, it is natural for us to ask why the gas men should act in this way toward a subject which is of such general interest. Certainly, no one part of the country alone can have its gas industry benefited by the exhibition proposed; but if any benefit can accrue to any particular gas companies, it will be to those companies round about Chicago—the companies of the larger cities touching Chicago in daily communication.

On motion of Mr. J. B. Howard, the whole morning session, if necessary, was to be devoted entirely to the discussion of this subject.

MR. A. C. HUMPHREYS—Mr. President and Gentlemen of the Convention, I wish, first, to express thanks for myself and for the Council for the opportunity you have given us to present this subject to you. I think, first of all, we ought to understand that this is a meeting to *discuss* the subject, and not one to be devoted to set speeches or anything of the kind. Any of those who have questions to ask will be kind enough to ask them and give us an opportunity to answer them to the best of our ability. We know there is considerable misunderstanding with regard to what the Committee representing the gas industry intends to do and has been doing, and we believe those misunderstandings can be removed. In New York, at the time this Council was organized, there were invited to that meeting all the gentlemen whom we knew of as being specially connected with the several Association committees, etc., but it seemed afterward that some mistakes had been made in that direction. Of course mistakes are always made in matters of this kind, and it is only fair that we should have an opportunity to remove any misunderstandings so created. When we got through the vote was unanimous as to what we purposed doing, and there was the best feeling in regard to the whole matter. It was recognized that we had a very large undertaking on our hands and some felt more or less discouraged. I, for one, did not feel discouraged. I felt that a strong appeal made to the gas men of America would bring out the right response. While to-day I am not discouraged, and while I believe the thing is going to go through, yet I believe we must do something else which we are not now doing, and this is an effort in that direction to bring about a right feeling among the gas men of the country. We have to have the subscriptions in hand within the next two or three weeks. We are all apt to look upon this as a matter of '93; but with the gas men it is a matter of '92—the building has to be finished and turned over to the World's Fair authorities in October of '92. Some will say at once that we might as well give it up, that it cannot be done; but we believe we can do it, and we believe we can get the money, if we can bring about the right feeling in this Western Association. This scheme has got to go through and not fall through. A good many years ago, when I first moved to Philadelphia, I remember attending a meeting—a general missionary meeting, I think it was—and it was expected to get from each person in the United States interested in the subject a subscription of $5. That was all. It was going to do a wonderful amount of good in the way of putting up mission buildings for the Episcopal Church, and I have never forgotten a speech made by a Doctor of Divinity from Baltimore. He had managed, as he always did, to secure the full attention of everybody in the large Academy of Music. His speech was frequently interrupted with applause; but he stopped suddenly, changed his entire tone, and said: "Gentlemen, that is all right; but this thing has been before you now for two or three years, and I am afraid that all this enthusiasm or a great deal of it will be forgotten. I want you, if you can, to let the applause go, and that every one of you when you go away will send in a $5 bill and never mind applauding me." I think we all come here with that idea, and I hope you are going to send in your subscriptions. Now, then, as to the work we are engaged in; I think you will find, if any of you have any suggestions to make, we will be glad to receive them and act carefully thereon. We are trying to represent the whole industry; we are trying to get up an exhibition that will be second to none, and hope to go ahead of anything else previously done in this direction. I was struck in the President's opening address by his reference to the companies who refuse to send their Superintendents to these meetings. We know that has been a cause of complaint in a good many quarters through the United States. I know I have had to meet that difficulty, and meet it quite seriously. And I believe the same companies that to-day are lukewarm in this World's Fair matter are the same companies that will be lukewarm in the other; and if you gentlemen are convinced that these sort of meetings help us, I do not see why you are not convinced that a general, concentrated gas exhibition is a good thing. I do not want to take any more time trying to make a speech, because I cannot make one. I want to simply open the subject, and we want any information on the subject that any of you gentlemen may have. We want you to ask us any questions, and give us a chance in answering them to answer the objections. The objections are what we want quite as much as anything else. I found lately, in taking the subject up with three or four people that I knew were lukewarm in the matter, that after a full discussion of the subject we not only secured their subscriptions, but in a number of cases secured most ardent workers in the matter, who will get subscriptions in other directions. I believe the same result will follow here if it will only receive a full discussion. That is all we are after at the present moment. I would state, further, that we have about $46,000 subscribed to-day. Probably from $5,000 to $10,000 more is just as good as subscribed. That is, I have it pledged by the Presidents of the concerns and that there is no doubt about it. Probably the $46,000, therefore, can be considered as $55,000. We need $125,000, which you will notice is considerable of a come down from the original estimate. You can readily understand that at first it was hard to estimate at all correctly as to what we wanted to do, but we have now had prepared preliminary plans and estimates by three architects, any one of whom will give us a thoroughly satisfactory piece of work. We now know that the building will cost us from $60,000 to $70,000; that will leave us, then, say, $50,000 for the equipment and maintenance of the exhibition during the six months.

THE PRESIDENT—I would suggest, Mr. Humphreys, that inasmuch as you have brought these preliminary plans and specifications, it would be well to explain them now, so that the Association may understand them.

MR. A. C. HUMPHREYS—Unfortunately, I am not now in shape to do it. We have two of the elevations here showing the pictures of the building, but there is no room here to make a display or to make any explanation. I think, however, that the plans are all self-explanatory, and I will arrange to have them in shape in whatever room you decide to make your permanent meeting room, so that at your leisure between the meetings you may examine them. All these buildings are designed to take the full space of 380 by 150 feet, with the front corners cut off. The one that is not here shown, the plan proposed by a Boston firm (Messrs. Shipley, Ruttan and Coolidge), has for its general idea a ground floor in which will appear most of the exhibits, simply a foundation upon which is to rest a Grecian temple—it is quite a striking and original design. Another is prepared by a New York architect, Mr. Bruce Price, who is quite in sympathy with the authorities in Chicago; and the other by the great firm of Carrere & Hastings of New York, who are also in sympathy with the World's Fair authorities, and know exactly what they have got to do, and are in a good position to estimate as accurately as it can be estimated by any one at this time.

THE PRESIDENT—Would it not be well for you to explain the character of the exhibition at this time. I think, perhaps, that is not fully understood by every one; and, as for the $50,000 which you propose to use for maintenance, what is that to be spent for? What is your idea as to how you will apportion that?

MR. A. C. HUMPHREYS—Of course you will at once see, as practical men, that that is what we would call a preliminary estimate. We have to provide in that estimate for a great deal in the way of contingencies. First, we have to put up the building, and then to equip it in all parts not actually occupied by the individual exhibitors. You will see, by the plans of these different buildings, large parts of each building are set aside for general purposes. For instance, one part of the building will be set aside as a headquarters for the gas men of America and their invited guests from the old countries. That part will not be a part of the public exhibition building; you will only have access to it by cards, the same as members to a club, and only subscribers to this fund will have those cards furnished them. That, of course, we hold out as a small bait; but I think it is quite a considerable one; for any man who has ever attended large fairs—and many of us attended the '76 exhibition, in Philadelphia—knows what a job it is to get any real amount of good from such a vast exhibition. The gas men of America can go to this exhibition and feel they have a headquarters where they can take with them their wives and families; where their wives can have retiring rooms, and where we can have our place to sit down and smoke and recover from the fatigue necessary to visiting such an exhibition. We will have guides; all the newspapers from the different parts of the country; and in every way we can so do we will make it a suitable resting place. I cannot specify at once all the conveniences of such a headquarters. In addition to that, we expect to have a part of the building set apart for general exhibits, outside of the individual exhibits, for which each exhibitor of course will pay his own way. The fact that a man subscribes to this fund of course does not relieve himself from responsibility for the ordinary fair charges. Now, we should expect to have historical exhibits, and should expect to get a good many hints from the work done at the Paris exhibition. There, as you will probably remember, the matter was covered by what they called the Gas Pavilion. It did not contain the individual gas exhibits, but simply contained general exhibits. Now, perhaps this is as good a way as any to show you what we expect to do with $50,000; we expect this buiding not only to contain the individual exhibits, which at the Paris exhibition were contained in an ordinary building, but we expect to show what was shown in the Paris Pavilion and a good deal more; and you can readily see that it is going to take money to equip it in the first place, and then after that to maintain it. For instance, we want to show rooms specially lighted, the light being used not only for illumination but also for ventilation. We want to show gas as a means of power in every way possible; we want to have a kitchen, and show it probably in connection with the regular restaurant at which our subscribers can have their meals. This subject will also be covered by a translation of the book gotten up by the Paris gas people after the exposition, entitled, I think, "The Gas Pavilion." This elaborate report has been translated and is going to be generally distributed. I know that 2,500 copies have been placed at the disposal of the Gas

Council, and I presume we will send them around. We shall probably be put to some expense if the several American Associations should decide to ask the foreign gas associations to become our guests here at a general gas congress—which has been proposed, I would say, by a number of correspondents of the Council in foreign countries. Dr. Bunte and some of the French representatives have proposed that thing, and we find that the idea originated with some of the Americans who went over to Paris and said we were going to have this exhibition, and that it would "knock out" anything that they could get up over there; and they are rather expecting this thing. I do not know what will become of us if we have to tell them we are unable to raise the funds after all our boasting.

THE PRESIDENT—This discussion is open to the meeting, and we would be glad to hear from anyone who has anything to say.

MR. A. C. HUMPHREYS—I would like to say one thing more, that we are open to questions, and we shall be glad to have them, that we may answer them.

MR. WM. McDONALD—I feel it is somewhat due to me that I should say something on this subject this morning. I have been intensely interested in the World's Fair matter since my appointment by the American Association on their Committee. Some talk and some questions have been raised in regard to the relations of the American Association Committee to the Council. I can only say in regard to this that I called a meeting of the American Association Committee, to be held the same day in New York City that the first meeting was called which organized the Council. The unfortunate thing about the American Association Committee was this fact—they were too widely separated. It is a misfortune to appoint a Committee that you expect to do work whose members are spread all over the United States. It becomes a matter of very great expense and of very great time for the members of such a Committee to get together, and unless they do get together, they cannot do efficient work. The American Association Committee had gone to Chicago—I had called the first meeting there—and it had done considerable preliminary work toward securing a place, but had been somewhat discouraged. When the meeting was called which organized the Council in the City of New York, every member of the American Association Committee was invited to be there, and about half of them were present. Those who attended that meeting, and, as Mr. Humphreys says, every person who has ever been at these meetings of the Council has thoroughly and heartily indorsed whatever the Council has done; and I come before you this morning, gentlemen, to say that I believe the Council is earnest and honest in its work—every member of it. Not only that, but the Council is in a very peculiar position, and for this reason: If we go forward with this work and begin to erect the building, the individual members of that Council will have to assume the expense necessary to do it, unless the money is furnished by the gas fraternity. If, on the other hand, they say they cannot go forward, they have to stop. I believe the Committee will go forward, but the gas people of America will deeply regret that they ever allowed this scheme to fail. I said to a number of people here that I thought perhaps some of the gas fraternity of this country, believing they were too prosperous, felt that the industry did not need advertising, which was one reason that *they* do not come to the help of the Council to push this matter forward. It does not matter how the Council was organized or just how this matter came up. Perhaps it was not just in the line that every man would approve, and it may not be in the hands of just the people that every person approves, but the question is now before us whether we shall go forward and complete the work which has been begun, or whether we shall lay it down. So far as I am personally concerned I do not expect any advantages from it, but I do believe it will be of great gain to the gas fraternity of the country. In talking with individuals I formed the idea or basis of what I am going to say here this morning in regard to the matter. I have had a number of people say to me, "Yes, unquestionably this exhibit will be of great benefit to the gas appliance people, the people who manufacture benches, holders, retorts and those things. Undoubtedly it will be of great benefit to them. They display their goods, which is an advantage to them, and it will result in an increase of their business." That is what they have said, and I believe that is right. I believe it will; but tell me, gentlemen, how it will bring one dollar to the manufacturers of gas appliances before the gas companies are first benefited? Who buy these goods? The gas companies buy them, and once they get them they are going to sell the gas that this apparatus will either produce, convey or register. What benefit is that *continued* sale of gas to the manufacturers of gas appliances? Only this, that in the future the companies may have to enlarge their plants. The gas companies are first benefited. I think Mr. Humphreys is very modest in this matter; more so than I am. He does not say altogether what is intended to be represented. He does not show you how this exhibition, through its object teaching, will attract the attention and careful thought of the public as to possibilities in the use of gas that they never even dreamed of. To-day, in New York, as in all the larger cities, Chicago, St. Louis, Cincinnati, Baltimore and so on, great buildings are being erected without a gas pipe in them, as you all well know. Why? Because it is said that the electric light is superior to gas for lighting a fine building and a large building. This has been brought pretty strongly before the public mind, and the public mind is very strongly charged with the fact that electricity is better than gas for lighting a building. Now, it is intended to be shown in Chicago—and one of the main features which we wish to show—that a building ventilated and lighted by gas is the most perfectly constructed building that can possibly be erected. And if this can be shown is it not worth a great deal to every gas company, and will it not largely extend its business? Do not we want to advertise our business? Do not the gas people of America want to advertise, and not let the electric light people have the whole thing to themselves? I think if every gentleman here could have gone through the week I went through in Chicago, in trying to get recognition from the people there, he would feel that no effort could be too great to make a showing of the gas industry at the Chicago Exhibition, and I think I can speak for every member of the American Association Committee when I say that he and the whole Committee are in hearty accord with this movement; that they will do all they can to make it a success. (Applause.)

THE PRESIDENT—We would like to hear from some of the other gentlemen. Is anyone in the room particularly opposed to the gas industry making an exhibition at the World's Fair? If so, we would like to see them and hear what their reasons are.

MR. LANSDEN—Mr. President, my friend Clark insists I am the one who should respond to that. I will say I have a personal feeling which I do not think is right for a man to bring into an institution of this kind. The Commissioners of the Exhibition in Chicago have, as I understand it, set apart an immense amount of money for our competitors—the electric light people. I speak of this as a personal matter. I believe my Company has done about as well as any other in making its subscription. I believe I shall do nothing myself personally to assist the Exhibition in Chicago after having been snubbed as we have been. What I should have done, and what I would be willing to do, would be to go to Washington and fight that appropriation of five or seven millions that they are trying to get, until they agreed to erect a gas building and treat us exactly as they have treated the electric light interests. (Applause.)

MR. A. C. HUMPHREYS—I would like to say one word while it strikes my mind in regard to the points raised by Mr. Lansden. As he intimates, his Company has come forward nobly in this matter. It was one of the first to go on the list, and for a large amount; but I am sorry to see he does not individually approve of our course. Perhaps, however, more has been done in the direction that he points out than he is aware of. The World's Fair authorities did attempt to refuse recognition to gas in this whole matter; they assigned us finally a space which was satisfactory, but they broke their promise and gave us a site which was not satisfactory. We did use that threat of standing in the way of their appropriation to secure from them a favorable site. Our architects now tell us that we have nothing to wish for as far as that is concerned. Now, I also studied the question up in Chicago; of course, I did not stand on that side of the argument, and while I was there with them they certainly partially convinced me that we are not altogether without blame in this matter. There was an effort made by the World's Fair managers to get information on this subject, and they did not obtain it; but I took the ground that they should have done so. They raised as a defense that other interests appeared before them, and the gas interest were not represented; therefore, the classification as made up excluded gas as a *special industry*. Had we been present we could have secured our rights; so they claim. On the other hand, I claimed it was not our business to be there to secure our rights—there was nothing partisan about such a matter as the World's Fair; it should be simply a question of making a classification from the information they gained, from outside and disinterested parties, and having that classification a fair and representative one. Now, when I took up with the Director-General the question of getting an amount of money from the World's Fair authorities for the erection of the building, he pretty well convinced me that it would simply result in our injuring the World's Fair without doing ourselves any good, as the appropriation could not go through with an amount of that kind in it. The money they are trying to get is for an entirely different purpose—it is for the government purpose of maintenance—and Congress would not allow a special item for the erection of any one industry building to appear in the appropriation. He went on to say that we are not entirely alone in this matter. For instance, the leather industry had come in at the last moment, and asked for a special assignment of space. They had to put up their own building. The remarks of Mr. Lansden also call to mind remarks that have been made by other parties in this matter. One gentleman said, I will not go into this because I do not feel that with $250,000 you can make a fair exhibition as compared with electric light. We say we who have looked into the matter think we are better posted than he is—it is fair to suppose that seven intelligent men ought to be able to know more about it than any one individual who has not given any special study to the subject. We now think the first estimate of $250,000 would give us a great deal more money than we require, and we have finally been forced into the position of coming down to a fine estimate, and we believe that $125,000 will do all we want. You have to bear in mind in connection with this point that the electric light industry has not got its own building. The electric light industry simply occupies part of the building devoted to electricity in general. We have got the gas industry alone to take care of, and we do not have to compare with the large building of electricity. We have simply gas to take care of, while they have the whole realm of electricity to take care of. This fact occurred to me; but of course I did not speak of it while I was in Chicago. While we would have one building devoted to our industry, they would be absorbed with all the other interests in the same line, and I think the greatest opportunity of gas to show up against electricity is going to be lost if we do not take advantage of that opportunity. We have a chance to concentrate in a building amply large enough for our purposes. We have fought for our rights and must maintain them. Having so far maintained them on your behalf, we cannot afford to have this scheme fail, and have the electric light people go out there and educate the World's Fair authorities and all visitors to the point of saying that we are a back number. What will be said if we fail? They will say that these men came and made a great fuss about their rights, and then could not raise the money for their special exhibition. They will say that it affords a demonstration of the truth of their charge that our industry is a back number.

THE PRESIDENT—The discussion of this subject seems to be all on the one side. We would like someone to stand up and give reasons why this industry should not go forward; why the gas exhibit should not be made—whether they think so or not makes no difference.

MR. EGNER—I wish to offer at this time the following resolution:

Whereas, We, the members of the Western Gas Association, believe that a suitable representation of the gas and related industries would be of vast benefit to the gas companies of America, and believing that the action already taken and proposed by the Council represented here is the best method to accomplish the same; therefore be it

Resolved, That the Western Gas Association indorse with their approval the efforts of the past and present Committees and the said Council, and recommend that the gas companies and others interested will take into prompt and favorable consideration the furnishing of the necessary means to carry on the good work as mapped out by said Gas Industry Council.

THE PRESIDENT—Mr. Egner having presented a resolution, the discussion will be upon the resolution as well as upon the subject in general. Capt. White has been asked for; I believe he is in the back room. We would like the Captain to please come forward.

CAPT. WHITE—I have nothing to add to what has already been said on the subject. I do not think the gas men of the country need the slightest urging. They certainly know their duty in this matter. Each man ought to remember that this is a matter which will never occur again in his lifetime, and he should go home prepared to say to the directors of his company that they do their part in subscribing toward this exhibition. It is a mere trifle, yet it will furnish money enough for this Council to go forward with its work, and unless we can go forward in a proper way there is no use of attempting it at all. Mr. Humphreys has said our electrical friends are to be assisted by having a magnificent building and will be advertised by the wonderful display that will be made there. We have to fight this fight single-handed, and if the companies in whose interest the fight is to be made have no interest in it, of course it might as well be dropped. I simply feel. as a member of the Council, that it is my duty to urge personally upon every man that he should do his best to assist us. I do not see that there are two sides to this question at all. We either have to secure a representation of our industry or take the position which the electric light people desire to put us in—that we represent a fading and expiring light. They will point back to this exhibition, and to the gas people, and say that our light is the one that failed, and I think we shall deserve it.

The President—I think the question is, shall this exhibition be held or shall it not? I have tried to draw out some one in opposition to the project so that the members of the Gas Industry Council would have an opportunity to answer whatever arguments were put forth. No one seems willing, however, to put himself on record on that side of the question. I think the gas company I represent is one of those that do not care to push forward this exhibition, and I would like to give some of its reasons, as these were given to me. I would like afterward, if any one else has considered the same reasons, to have him say so. My people have said to me, in the first place, that the list so far showed that none of the western cities are contributing. I think, therefore, they are only waiting to see a contribution made from some one of those larger companies. They have also said it was understood that the Chicago Gas Light Company would not contribute. I think this is a strong point against it made by many. They say they understand that the Chicago Gas Company is to furnish all the gas that is to be used, and to have pay for it at regular prices. That is another point against it. But the executive officer of the Company says that if the Sisters of Charity, or the canvassers of some other charitable institution, should come along and ask him for a subscription, if he saw the name of the prominent merchants along the street, on that subscription, ahead of him, no matter whether he may be inclined to give or not, he would not want to take a back seat, and he probably would put his name to it in an amount in proportion to what the rest were giving. It would seem, therefore, that if all the companies would step forward and say at once, we will give such and such an amount, it would have the effect of drawing the others on. I hope, gentlemen, you will present such argument as you may have in mind on either side of this question at once that we may get through with it. We have with us one who will become a member, but has not yet been elected. I believe he feels a little delicacy on this account. I would ask Mr. Stiles, of Chicago, to give a little information on this subject.

Mr. Stiles—I do not know that I can give you any information, and this is rather an embarrassing place for me to speak. I contributed funds and called the first meeting of the electric light people to form the National Association in Chicago, and was the first President of the Electric Light Association of Chicago. I have attended a great many meetings of the electric light men, commencing about a year ago, in furthering the interests of the electric light companies at the World's Exposition; and I had somehow gathered the idea that the gas men did not care to be represented at the World's Fair. I suppose that this is one of the reasons why the World's Fair Committee made so little provision for the representation of the gas business. They have had before them almost constantly committees from the Electric Association, and from the electric companies, and have appointed, as a superintendent, the Superintendent of the electrical department at Chicago; but I am glad to see that the gas companies are now taking an interest in this matter. I really had thought, as far as any representation at the World's Fair was concerned, they were dead. I have probably derived this idea from being present at several meetings of the electrical companies and the Electric Association, in which the representations at the World's Fair first started, and have been continued; and I will say that the electrical people are entitled to a great deal of credit for their energy and foresight in taking hold of this thing at an early day. And it seems to me that now is the time, and the only time, for the gas people to get an exhibition. I must say that I agree with Mr. Humphreys that a special building for the gas business will be a great deal better representation for the gas interests than to be in any building, for instance, like the electricity building. Now, it strikes me that the sentiment here seems to be universally in favor of this committee going ahead, and I would suggest that such companies as can make their subscriptions do not wait until they get home to do it, but that it be done here at once while the thing is hot. It seems to me this is the proper time, because when a man goes home to do anything he has other business to attend to when he gets there, and he is apt to delay matters of this kind. It appears to me all the companies represented here by people who have an authority to make their subscriptions, should make them at once. As I said before, I feel embarrassed because I have been in the electrical business for the last ten years, and I suppose have been about as hard a worker as there has been in that line. I probably have invested as much money in experiments as any other individual in the United States. (Laughter.) It is my opinion that if the gas interests are properly represented there it will be of immense value to the different gas companies of this country. It has been generally understood by the electrical people that somehow or other the gas companies had been in operation so long and made so much money, that now they were willing to step aside and let the electrical people do all this business. I suppose the Company of which I was President had put in as many electric companies as any other in the United States at the time they quit business. I am thoroughly convinced that the gas business is in a better state to-day, and that more improvements have been made in the last ten years in that business than have been made in the electrical business, as far as furnishing light with economy is concerned—for I have not been able to see in the last few years how electricity can be made any cheaper than it has been made heretofore, and I am convinced that gas is being produced cheaper and better than it ever has been before. (Applause.)

Mr. Hauk—I am from Chicago, representing a certain interest there, and I wish to say that our Company and myself are in hearty accord with the gas industries there. There are certain reasons why we, perhaps, have not been very ardent in this matter. Before coming to this convention I consulted with our people and stated that perhaps the question would be brought up, asking what they thought would be the proper thing for our Company to do. Naturally, they asked my advice on the subject, which I gave them. They said, do whatever you think is best; we are certainly heartily in accord with the movement. We are perfectly willing, and I am authorized, gentlemen, to make a subscription. That is what we want; we want money. I am ready to make the subscription of our Company now, and will subscribe $500 at this time. Of course that may seem like a small subscription for our Company, but it is as much as we feel able to give at this time; but, as I said before, we are heartily in accord with the movement. (Applause.)

Mr. W. L. Brown—It so happens, Mr. President, that the Company I represent is the one nearest to the City of Chicago, and yet is not one of the city companies. I believe that an exhibition such as proposed would be an education to all who visit Chicago at that time; and I wish to say that, as representing a very small Company, we shall do our share in the proportion allotted, and that we shall be ready at any time called upon to give such a subscription.

The President—Mr. Gwynn, have you anything to say upon this subject?

Mr. J. Gwynn—I have listened with considerable interest to the remarks of Mr. Humphreys and the other gentlemen, and it strikes me, as Mr. Humphreys states, that some of the companies have been very slow in making their subscription. The Company I represent has made a subscription of over $5 a million, when the call was for only $4 a million. So far as I am concerned, personally, I will add a subscription of $100, if anybody in the room will follow me, independent of my Company.

Mr. Graeff—I will back you.

Capt. White—I have a letter here from the South which I desire to read to the Convention at this time: "If we conclude to hold the '93 meeting in Chicago at the Gas Building on the grounds, would it not be well to, and ought we not, invite the foreign gas engineers to meet with us? It is none too soon to have it understood that we will do so, even if we do not issue formal invitations at present? This is a matter I wish particularly to bring before the Council. In the matter of contributions to the building and exhibit, I would say that the Macon Company will contribute its $4 per million, which will amount to about $130, and I will have the Richmond (Ky.) Works contribute its quota. These will not be much in themselves, but if every one will follow suit the amount necessary will be forthcoming."

(Signed) ARTHUR E. BOARDMAN.

Before I sit down, I would like to take the other side of this question, for a moment. I understand two objections have been very strongly pressed among ourselves (men talking one to another upon this subject) as to why they do not contribute. One of them is that coal gas companies do not see how any benefit is going to accrue to them by having the exhibition in Chicago, where the exhibit will be made entirely with water gas. The answer to that is, I do not see what on earth the great public whom we are trying to get at, know or care whether the gas used is coal or water gas. They will use the gas in the towns where they live no matter whether it is coal gas or water gas. What we want to teach them is how to use gas for other purposes than lighting, and one of the objects of this exhibition is to use the argument that gas is not a back number—in fact, that there are innumerable uses to which it may be put of which they have absolutely no knowledge. Another fact which seems to be troubling our friends, and it has troubled me on occasions, is that the United Gas Improvement Company seems to be having something to do with this. While I have nothing to do with that gigantic corporation, and, indeed, have no unusual love for it—do not get out of my bed at night to pray for its prosperity—simple justice is due to it from the fact that it has paid the full assessment on the output of its several Companies, and lent to the effort now making the hearty indorsement of its officers. Some other companies might well emulate the action of this gas "boogie-man" and put their shoulders to the Columbian Fair wheel. It is only fair to say that the gentleman connected with that organization who is in this Council is doing useful work, that none of the rest of us were able to do. Mr. Humphreys reluctantly took the stroke oar as our Secretary and is doing hard labor. Not a single one of the seven gentlemen selected for this purpose but who would be very willing to step aside and let any other take his place that you or any gas association may select.

THE PRESIDENT—Mr. Croul, do you care to express yourself as to the feeling of the Detroit Gas Company upon this question?

MR. CROUL—Upon receiving the letter from the Council this matter was laid before our Board and they proposed to wait in order to get a little further information. I will say this, gentlemen, we are prepared to do something for the Council, and by the time this convention breaks up, and I have had a little conference with Mr. Humphreys, we shall be ready to do our share. I am now speaking for myself as one of the members of the Board. Our President is not here, and as Vice-President I will simply say that we propose to be in the swim.

MR. JENKINS—As a representative of one of the companies that I think will have the least benefit from the exhibit in Chicago, being so far away and so small, I want to say that we will be in the swim also to the amount of our assessment, $4 a million, or about $60.

MR. HIGHLANDS—Mr. President and gentlemen of the convention, I am not yet a member of this Association, although I hope to be; but I rise against the resolution, for this reason amongst others: I have discovered in my experience that resolutions do not always bring money. You can pass that resolution, but by its passage how do you get the money? One of the first questions that strikes me is what benefit will it be to the small companies to raise this fund? I represent a small Company, probably with an output of 25,000,000 feet a year, which is 130 miles from Chicago. What are we going to gain by it? An enormous amount of money has been contributed by the Exposition toward stimulating the electrical industries, and they say gas is a back number. All of us have found in our experience what electricians can do. We are able to answer the question as to what they have done and what they can do, and how much they are to be feared. My own experience has been something like this: When I commenced the gas business in my present location about one year ago I found nearly all the lighting was in the hands of the electric light company. We rebuilt our gas works and got in shape to care for our business, and last August we turned on gas of 24-candle power and kept it up. On the 1st day of October over 75 per cent. of the commercial business of the electric light company was in our hands, and before the 15th of October they wanted to know what we would give for their plant. We did not want it, but they kept on asking, and, as we are a charitable institution, we finally took them in, and now have all the lighting business there. There are other men here who stand in the same position that we are in, who may well ask, what will we gain by this exhibition? Shall we put our money up to make an exhibition in Chicago when the entire management has been against us all the way through? Can we hold our own against the electric light in spite of the exhibition in Chicago if we do nothing? I firmly believe we can.

MR. McDONALD—Just one word more, suggested by what Mr. Highlands has said. I think no one can contradict the fact that human progress always comes from human effort, and that if we sit down and do nothing we certainly are a dying concern. If, on the other hand, we put forth an effort, we increase our strength, and on that principle this gentleman will be benefited if he makes an effort, and if we all make an effort the gas fraternity and the gas business of this country will be greatly benefited by the effort put forth by the gas people.

Mr. Stratton—I think the last speaker on the left (Mr. Highlands) has answered his own argument in stating his own experience with the electric light company where he lives. The same effort put forth in Chicago on a large scale will certainly bring forth as good a result there.

Mr. Smedberg—Another point in regard to the argument of the same gentleman. He comes here to us and applies for membership. What benefit can it be to a small company? (Laughter.)

Mr. Gribbel—An impression has got abroad, I think, that nothing has been done by the Chicago Companies on this World's Fair business. I would like to ask for information—if they have done anything?

Mr. Shelton—I will say that the Chicago Company has made an extremely large contribution. They have put up, I think, $50,000 to the general World's Fair fund, part of which goes in as a citizen of Chicago, and part as a gas contribution.

Mr. Merrill—I think the ground has been pretty well gone over. I have no speech to make, but I have a sort of confession to make. I received the circular sent out by the Gas Industry Council asking for $4 per million. I want to confess that I scored that down a little, and I think I did wrong. I subscribed $50, and it ought to have been between $60 and $70. I will now make it $100, which will make our subscription about $6 per million.

Mr. McDonald—The question was asked in regard to the Chicago Company, and I thought it was no more than due to say that when I was in Chicago with the Committee of the American Association I visited the offices of the Chicago Gas Light Company and was received very cordially. We talked the matter over, and while I do not know that they would like me to say for publication everything that was spoken at that time, I believe they feel the importance of the matter. The feeling has gone abroad that they are not going to do anything to help this exhibition, yet they assured me that if the gas people would do anything in Chicago, or could succeed in doing anything, they would certainly help them as far as they felt they were able.

Mr. Egner—The gentleman wanted to know what good it would do the small companies to have this exhibition in Chicago. I think I can give some practical suggestions. Architects and others will go to that exhibition, and, as Mr. Humphreys has suggested, they will see how gas is supplied for cooking and for other things that they have not thought of, and there will be an exhibition there such as no one ever before has seen. They will see what can be done with gas. They would probably, after saying, "What good is there in gas?" conclude by remarking, "Well, let us go and see it, anyway." They will then see the different uses to which it may be put, and especially I would make the point that architects will see what can be done with gas. They will get ideas in that way which will be of benefit to every company in the United States. The scientific papers and the newspapers will take it up, and the small companies may get more advantage from it than the large ones, who do not need it so badly.

Mr. Higgins—I have a personal subscription of $100 to offer, and have to say on the part of our people that we have now largely contributed to the general fund, and the question has been put to me a number of times as to what we were going to do. I think this matter has been fully explained to the Council.

Mr. McDonald—Before this discussion goes on any further I would like to make an explanation. Speaking of the manufacturers of gas appliances, they will be expected, in the first place, to pay their own expenses for their own exhibition. I find there is a little misunderstanding in regard to this—as to the money that is being contributed now. It is not to go toward any exhibition of gas appliances, but to the erection of the building and the exhibition of gas. Am I not right, Mr. Humphreys?

Mr. Humphreys—Yes, you are right about that. I would say further that a great many of the points that have been discussed here are very fully covered in the circulars which we sent out; and if the gentlemen of the convention will take the trouble to read carefully the circular of April 9th, they will find many of these matters fully explained. In that circular we endeavored to give specifically the reasons why gas companies should contribute, though we do not pretend that we have covered all the ground. There is the point of the education of architects that Capt. White has spoken of. I was told by architects whom I consulted that there was a very distinct advance in that direction which the exhibition at Paris suggested, and that a number of American architects had come over from there with their ideas totally changed as to the future of gas in connection with the construction of buildings. On the strength of that suggestion alone I believe that every company in the United States can afford to subscribe toward this fund—even Mr. Jenkins' Company, no matter how far it may be from Chicago. I want to speak about one or two other points that have been already spoken of. It has been remarked that the large Western companies have not subscribed. I am not prepared to state exactly all that has been done in that direction, but I would say that there is misinformation in regard to the matter. A number of the large Western companies have subscribed informally, and it is simply through the inability to get Directors' meetings, and so forth, that we are unable to publish all the names. The question of Chicago has already been answered. The Company there subscribed $50,000 to the general World's Fair fund, and they feel reluctant to give up any further amount for this matter. I think they are wrong, however. I think each matter should take care of itself. If it were worth $50,000 to them to subscribe to the general fund as a local Chicago concern, it surely is worth something to them to be represented in this special gas exhibition. The fact of their general subscription has nothing to do with what it is worth to them as members of the gas industry in general. Still, that is a matter for themselves to take care of. As to their furnishing the gas for the exhibition at regular prices, I think there is also some misinformation in that direction. I do not think it is very good business to furnish that gas on its merits alone. They have a large amount of pipe to lay and many other things to do, and I do not think any criticism should attach to that Company on that account. I think the officers of Mr. Cowdery's Company use a very poor argument against subscribing. The executive officer says that if it were a subscription for the Sisters of Charity, or anything of that kind, he would first look at it and see who is there before him. I think a matter of this kind should be decided simply from a consideration of what is right, or of what is to our business advantage. We ought to say, is that the best thing to do? Some raise the question what will become of the subscriptions if the matter does not go through? Why, of course, they will be returned. You have not put any money in any way, and I do not see that there is any reason for any fear on this score. You do not give us any money; you simply say what you will do, and the subscription is credited to you. I think there are three subscriptions which have been paid, amounting only to $108. If this matter falls though we shall ask for no money, or possibly ask for a small pro rata amount to cover actual expenses incurred. As to Mr. Highland's argument, I think the April 9th circular fully answers it, so that it is not necessary to take up any time on that account. With regard to whether we can get our money out of this thing, I think we can gain a good deal of information from Mr. Pearson of Toronto. You know that he was one of the first large subscribers. Mr. Pearson was led to do that from his own experience. His Company had subscribed $2,500 toward a city exhibition in Toronto, simply for what benefit he could get from a gas exhibit in that town. He subscribed this amount for the general fund because he was convinced by that experience Now, if he could afford to put $2,500 into a little city exhibition where only the people of one locality came to see it, what can we afford to do where we have the whole United States? Of course, you have to bear in mind that the gas men themselves will also get a great deal of benefit from this. They will probably be able to learn as much there as if they travelled all over the country for weeks. They will have to examine and compare various methods and apparatus for doing the same thing. I cannot estimate the benefit this will be to me.

Mr D. R. Russell—I simply want to speak with regard to manufacturers, and I do this because I have had so many approach me in this way. They say this exhibit is principally for the benefit of the manufacturers, because they show their wares there and will receive orders for them. They say it is the business of the manufacturers, and they should pay for it. But they must take into consideration the fact that after this building is up they are at no more expense, or very little more; whereas the manufacturer must take his wares there at a large expense, stand the wear and tear, and return them to the place where they were sent from, or probably sell them at a discount. They will have to bear a large expense for maintaining this exhibit, having persons there to take care of it, distribute cards and give information regarding the wares or the appliances. I think if the gas men would appreciate that fact more they would probably make a larger subscription and make it more willingly.

MR JENKINS—I want to say to you how I expect to get back the subscription. On every gas bill that goes out in Columbus during the year 1893, or during that gas exhibition, I am going to print right across the face of it: "Are you going to the World's Fair? If so, be sure and see the gas exhibit, which will interest you." I think now that we have had a satisfactory answer to all the questions that have been asked. I move, Mr. President, that we adopt the resolutions offered by Mr. Egner.

The resolutions were seconded and unanimously adopted.

The convention then adjourned until 1:30 P.M.

FIRST DAY—AFTERNOON SESSION.

The Association reassembled at 1:30 P. M.

The President having announced that the reading of papers would be the first business order, called upon Mr. C. M. Higgins, of New York, who read the following paper on

PETROLEUM PRODUCTS—HYDROCARBON EMPLOYED IN GAS MANUFACTURE.

Mr. President and Gentlemen of the Western Gas Association—In dealing with the subject of this paper, assigned me by the Executive Board of our Association, I beg to make the following brief statements based on actual experience and close observation.

The first water gas plant, manufacturing illuminating gas, successfully using naphtha as an enricher, was established, as, perhaps many of you know, at Phoenixville, Pa., early in the seventies, while in several cities of the east, and in this city (Detroit), naphtha was being employed as an enricher to coal gas in the retort system. From this experimental stage, the different appliances employing naphtha in gas manufacturing have been advanced to that stage of proficiency that carbureted water gas is used almost entirely in the principal cities of this country, while our friends across the water are fast becoming interested in this subject.

Naphtha being a product of crude petroleum, it may be of interest to some of my hearers to have me explain in a simple manner how it is obtained.

The first condensed vapor arising from the crude oil still, in the ordinary process of refining or separating petroleum, is termed crude naphtha. This crude naphtha is placed in a still and passes through the same process of treatment as the crude oil; that is, the crude naphtha is redistilled, and the gas naphtha, above referred to, is a clean cut from the crude naphtha, and is a homogeneous product, and may be of different gravities, that most commonly employed in manufacturing gas ranging from 57 to 63° Beaume. In the redistillation all foreign matter is carried off, leaving a product free from the light and heavy gravities, and comparatively free from sulphur. With the use of proper heats this gas naphtha is all convertible into a high candle power illuminating gas, in most of the different processes employed for the purpose. Some of them, however, are mere manufacturers of lampblack or tar, using extravagant quantities of the raw material, and producing a small percentage of imperfectly unified or fixed gas. In gasifying naphtha, unfixed hydrocarbons, resulting in a deposition as tar, or a form of carbon being deposited in a finely divided state in the conduits or flues as soot, are rarely met with, provided proper heats are employed. Again, in using naphtha the avoidance of naphthaline in the works, streets or services is a feature that thoroughly recommends its use. It has been found, with naphtha as an enricher of coal gas, that the average run will produce per gallon 132 cubic feet of 20-candle power gas, increasing the illuminating power per 100 cubic feet of 17 candle power gas 3.25 candles, and, considering 11 gallons of naphtha to each ton of coal carbonized, producing with this mixture and proportion 12,425 cubic feet of 20-candle gas, approximately 5.12 cubic feet per pound of coal carbonized.* In obtaining such results, 83 cubic feet of 70-candle power gas per gallon of naphtha used is not far from the average in ordinary work, while in enriching water gas with naphtha it is found, on averaging out parallel runs in several different plants of the most improved type, that 35 pounds of Connellsville coke and 4.30 gallons of 59 to 63 gravity gas naphtha per 1,000 cubic feet of 21½-candle power gas is the average; while with the 36 pounds of coke and 4¾ gallons of gas naphtha a 23-candle gas has been obtained in a test of 30 days' duration. I refer here to the use of the cupola and not the retort system. I believe the results, as shown in some of the regular water gas plants favor a less quantity of naphtha than above by about 12 to 15 per cent., with increased quantities of coal or coke.

Quite recently the writer had occasion to review the manufacturing accounts of a water gas company, operating with crude oil, under the supervision of an engineer whose ability is unquestionable. In this plant of the most improved pattern the yearly average proved to be, per run of 1,000 cubic feet of gas made, 45 pounds of coke and 7.10 gallons of crude oil. Others, no doubt, are obtaining better results. I, however, question if the actual average yield obtained is very much lower than that just mentioned.

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* Verified by Frederick Egner, Engineer.

A few years since Ohio crude oil became a fad; many gas engineers, allured by its first cost, adopted its use; but, notwithstanding the improved appliances for its use, it resulted in a costly experiment. In working with crude oil, the expended engergy and the cost of collecting and marketing the non-gasified residual, commonly termed tar, so as to render it available as a credit to the cost of manufacturing, is undoubtedly an illusion. The loss of expended energy in working it is entirely lost sight of by many engineers, while in the average plant the quantity of crude oil used per 1,000 cubic feet, as against naphtha, more than meets the difference in cost. A comparison in four different plants, formerly using crude oil and now running on naphtha, favors the latter by about 40 per cent. In all I might add that I believe the references herein made to the comparative values and results obtained, are very conservatively put.

Uniformity in manufacture, the maintaining an even candle power of properly fixed, non-condensable gas, is to be welcomed in any plant. Short runs and even heats, with the use of naphtha, will enable gas engineers to reach that end; and thoroughly competent engineers and builders should recommend an even gravity gas naphtha as being the least expensive and most desirable material, as against crude oil or any of its other products.

The production of naphtha is constant, and this fact tends to make the price uniform, while the production of crude oil varies, and this variation accounts for the fluctuation in price. So in the long run it is fair to say that naphtha will be the preferable article of the two for gas making, because of the uniformity of price and the ease of working it, as against crude oil.

DISCUSSION.

THE PRESIDENT—I notice that Mr. Higgins has referred to Mr. Egner. We would like to hear from Mr. Egner at this time.

MR. EGNER—I received last Saturday morning a copy of the paper just read, and noticing the reference to myself, prepared some remarks I wish to read at this time. They are as follows: In dealing with the subject of his paper the writer has managed to tell us very little about that which one would naturally expect from the title of the same, and it appears to be mainly an effort to convince the members of this Association that, if they desire, or are obliged to use any hydrocarbons in their business, naphtha is THE thing, and the most desirable in every respect for the purpose; but while I can cheerfully indorse most of the reasons given, all should not go unchallenged. He (Mr.

Higgins) is, as we know, an oil and not a gas man, and interested in the extended sale of naphtha, which is his specialty; and because of these reasons is excusable for some of the statements which are not in accordance with the experience of most practical gas men, and certainly not with my own. Having for nearly twenty years used oil, either as an enricher of coal gas in preference to cannel, a carbureter of water gas, or making simple oil gas, and a number of combinations of oil, water, steam and air gas, I may claim to have had considerable experience in the use of the product which is the subject of the interesting paper which we have now heard. I, therefore, hope you will excuse me, if I, in the interest of our common reputation, undertake to slightly correct that one sided (so it appears to me) argument in favor of naphtha at the cost of crude petroleum, and at least one of its products—the so-called "intermediate distillate." The final paragraphs of Mr. Higgins' paper contain the only staple argument (within certain limits) in favor of the superiority of naphtha over crude petroleum, for gas making. At works under my charge for years, there never was found any great difficulty, when using crude petroleum, to get more candle feet per gallon out of that oil, as a rule, than from any of its products. Ohio (Lima) crude oil was used with advantage, from the time it was placed on the market until my connection with that Company ceased, about a year ago, and it proved of substantial benefit to that Company. As to the tar from crude oil found in gas making and its value, there is no illusion about that. The Company just mentioned was always paid full value for its tar from oil as well as coal, and I have seen at Wilmington, Del., a simple device invented by the very able Superintendent of the Wilmington Coal Gas Company, Mr. Thomas Curley, by means of which the tar from oil is collected without trouble—free from water—and is sold at as good a price as coal tar. In his paper Mr. Higgins refers to an engineer, whose ability is unquestionable (so he states), supervising a plant of the most improved pattern, whose yearly average accounts show that per each thousand cubic feet of gas made, he uses 45 pounds of coke and 7.10 gallons of crude oil. I hope that neither the name of the engineer, nor the said works, be given, and that, on the whole, there is an error in the statement somewhere. I trust that those who read the proceedings of the Fifteenth Annual Meeting of the Western Gas Association may rest assured that such a result is not a fair average sample performance and work of most American gas managers. Even with a plant, which is not of an alleged "most improved pattern," I should consider the results quoted as, by many per cent., below the poorest average generally known. However, crude petroleum cannot be used to such good advantage as naphtha in water gas apparatus of the "Lowe" and "Springer" type. Of cupola processes for making water gas the "Flannery" is, I think, the best adapted for using crude petroleum; and I agree with Mr. Higgins in this, that I would say to all who have the former class of apparatus, that naphtha will be the best for them, even at a somewhat higher price per gallon. A word about the different processes to which Mr. Higgins also refers. The mistake made in every cupola water gas apparatus which I have yet seen is that the fixing chambers are not large enough to admit getting the best possible results from any oil. You will admit that there is a great difference between *intensity* and *quantity* of heat; and it is the former which destroys much of what good there could be obtained from the oil in gas making. I venture to maintain that if the quantity of heat now usually confined to an intense form, in one or two so-called fixing chambers or super-heaters of water gas apparatus, were distributed in suitable vessels, over a larger area, that it would result in an astonishing saving of raw material. For enriching coal gas there is, as a rule, no better or cheaper material than naphtha. I have advocated the use of that article for that purpose—as most of you know—for many years. In December, 1887, and January, 1888, I published the results of several years' operations in making coal gas without and with naphtha as an enricher, and a description of how the work was and could be done. The statement now made by Mr. Higgins that, by using naphtha as an enricher, the naphthaline nuisance at works and in street mains and services would be avoided and cured, was one of the facts which I tried to impress upon the readers of the paper mentioned. The direct results, besides riddance from naphthaline, were that, with coal which by itself yielded per ton 9,780 cubic feet of 17 candle power gas, the addition of 4.8 gallons of naphtha produced 10,960 cubic feet of 19.6 candle power gas per ton carbonized. Theoretically it can be shown to be impossible that the addition in gas and illuminating power could have been obtained from the quantity of oil given; but the facts were that, without the naphtha and again with it, the quantity and quality were as stated. It has been, and still is, a subject of wonder to me why, with the incontestible advantages of naphtha as an enricher, it is not generally used, unless it is where good cannel can be had relatively cheaper than oil. The use of naphtha can only fail to be of advantage (excepting under the conditions last named) through ignorant or careless manipulation, or by deliberate effort to make it fail. Having stated these facts about naphtha, which I know to be true, I hope Mr. Higgins will pardon my not having been able to agree with him on all his points, and that you will all excuse my having taken up so much of your time in this discussion.

Mr. Jas. W. Dunbar—Mr. Higgins says that crude oil is uncertain in its production of gas, while the production of naphtha is certain. Naphtha is made from crude oil, and that being the case, how is the production of naphtha certain when the production of crude oil is uncertain?

Mr. Humphreys—I would like to say a word or two on this subject. I notice that Mr. Higgins says: "In all, I might add that I believe the references herein made to the comparative values and results obtained are very conservatively put." I would like to ask if that means that they are conservatively put in regard to the value of crude oil? There is no doubt that in this paper there is a direct comparison made between naphtha and crude oil as enrichers and as materials from which to make water gas. The comparison is practically made by stating that from 4.30 gallons of naphtha you get 1,000 feet of 21½-candle power gas. The paper then states that 4.75 gallons of naphtha will make 1,000 feet of 23-candle power gas; again, that some of the retort systems will give even a 12 or 15 per cent. better result than this. But the very next paragraph states that it takes 7.10 gallons of crude oil to make 1,000 feet of gas, candle power not stated, and as we presume that it is a comparison, therefore, we will assume that it is a 23-candle power gas. Now 23-candle power gas from 4.75 gallons of naphtha would be 5 candles to the gallon only—not a high result. If we take the 15 per cent. increase credited to the retort methods we still find there are only 5.9 candles to the gallon—a first-rate result, but not by any means unattainable by cupola processes with crude oil. Then it is stated that 7.10 gallons is the necessary amount of crude oil to do the same thing, which means that you would only get 3.25 candles to the gallon. I thoroughly agree with Mr. Egner that if there is anybody in the United States, with a modern apparatus—Mr. Higgins states that it is the most improved apparatus—that is only getting 3¼ candles to the gallon of crude oil, I am sorry for the gentleman, for he is getting no such result as he should, and I am sorry to have any such result recorded in the minutes of this Association. Now with crude oil, at some of our works, we are doing better than 5.9 candles to the gallon. I will go still further and say that with apparatus five years old, and, therefore, not of the type specially designed to handle crude oil, we are almost getting 5.9 candles per gallon with crude oil. With regard to the tar made by use of crude oil, we simply must regard that as a residual worth from 4 to 10 cents per gallon, and, therefore, worth more than the oil from which it is produced. Again it is further stated: "Short runs and even heats, with the use of naphtha, will enable gas engineers to reach that end, and thoroughly competent engineers and builders should recommend an even gravity gas naphtha as being the least expensive and most desirable material, as against crude oil or any of its other products." That practically means that if I or any other gas engineer here does not recommend naphtha to our friends or companies as being the best material, we are not competent. Of course I have no doubt that was not intended, but that is the way it reads. I agree with the gentleman who spoke last (Mr. Dunbar) in that I cannot see why the argument holds as to the production of naphtha being constant and the production of crude oil being otherwise. It seems to me they must hang together: and I would like to ask Mr. Higgins the direct question as to whether he claims that in the last five years the prices of naphtha have been held at such an even figure as to afford security to the gas engineers of America in making up their estimates of future cost. I will say that in advising my Board of Directors, after considering the case very carefully and making some special tests at some of our biggest works, I was unable to recommend that I would pay two one-hundredths of a cent more for naphtha than for crude. I will say further that, with the superintendents and engineers of our Company who have had experience with both, if they were asked to give an honest opinion on the subject, and the question was put to them in this way: "If you were the owners of this property, which would you prefer to buy at the same price?" those superintendents and engineers would unanimously say: "Give us the crude." In fact they have so expressed themselves recently; namely, at our last annual meeting of Superintendents and Engineers. The question was put to them in this way: "Answer as if you were the owners of the property; those of you who have had no experience with both are not to answer, but those of you who have had the experience with both will do so." There was not one vote recorded in favor of naphtha, and the result was that after that meeting those superintendents who had voted came to me and asked that I should not buy naphtha for them if we could buy crude at the same price. Of course the apparatus must be properly designed for the handling of the crude oil.

MR. HIGGINS—In making reply to Mr. Humphreys, I wish to say that he has in his statement very thoroughly covered the entire question and has gone through the paper very thoroughly. I must confess I am not a gas engineer, and therefore I know very little about the points Mr. Humphreys has raised, with the exception that at quite a number of places where we have introduced the use of a heavy naphtha, we found that they were running with even larger quantities of crude petroleum per thousand feet of gas than I state in my paper and were glad to pay a premium for the distillate. We, of course, feel when a gas man demands a certain grade of goods he can have it. We are not selling crude oil or naphtha unless he wants it; anything a gas man wants we are willing to give him. In Mr. Humphreys' business, like in other corporations, they have a careful system, and I have no doubt that it is worked out very carefully at all points, as in the calling together of gas engineers that are operating at these different places, and in making their comparisons they should be able to obtain better results than a man who is on the outside. I know from meeting the different people outside of the companies that Mr. Humphreys represents that he is doing better; but I doubt whether those in the country at large in the different gas works are obtaining much better results than those given in my paper.

THE PRESIDENT—Will Mr. Higgins please explain to the gentlemen his statement that the production of naphtha is constant and that this fact tends to make the price uniform, while the production of crude oil varies? Mr. Dunbar and Mr. Humphreys both asked an explanation of that.

MR. HUMPHREYS—I asked one other question, as to the security enjoyed by gas engineers during the last five years as to the unvaried prices of naphtha.

THE PRESIDENT—I think we would be interested in having Mr. Higgins explain that also.

MR. HIGGINS—The same variation in price is true of crude oil that we find with naphtha. The prices are really no higher to-day than they have been for some time past, and as the production falls off, I presume likely we shall see prices advance in that product. On the other hand, in running crude oil, refiners are obliged to produce naphtha; they have more or less of it to market. This is true of any refiner; and they are enabled to sell this light product at a very low price as compared with crude oil. As I have stated heretofore, a great many gas men prefer to use naphtha; again the production of crude oil varies, and this variation accounts for the fluctuation in price. All crude oil does not produce the same quantity of naphtha. From some grades of crude it is possible to take a larger per cent. of naphtha than from others. I think this covers the question raised by Mr. Humphreys.

MR. EGNER—I only wish to say I was in hopes Mr. Higgins might be excused from answering those questions. He is in the business of selling these things and it would be rather like getting the secrets of the trade, which, no doubt, he would feel reluctant about giving.

THE PRESIDENT—Mr. Higgins is at liberty to refuse to answer any questions asked, if he sees fit to do so.

MR. SOMERVILLE—I suppose it is understood very well here that naphtha is not made exclusively for gas works. There is a very large demand for it outside of what is required for gas purposes, such as in varnish works, etc., and I have no doubt at all that this was in Mr. Higgins' mind when he wrote that paragraph that the production of naphtha was constant, while the demand and supply of crude oil were fluctuating. The whole question to my mind hinges upon the price of the two products; if they are nearly equal, it will be much better to use naphtha. My experience in the use of crude oil confirms exactly what Mr. Higgins has said. It was a failure in every way, both in economy and candle power. The odor was a nuisance to the neighborhood, the pipes choked up with pitch or tar, which was productive of expense to keep clean. We gave it up and returned to the use of naphtha. No doubt there are other systems of making gas where this trouble would not occur. When I saw the title of his paper, "Petroleum Products," I expected Mr. Higgins to say something regarding the production of oil in this country, a subject on which I am sure he is well qualified to speak. It is a question continually coming to the front, especially when we are considering an enlargement of the works for the production of water gas. Is the supply of oil lasting? Will the price remain as it is? These are some of these things I expected to hear from Mr. Higgins.

THE PRESIDENT—It seems to me very clear that Mr. Higgins means the production of crude oil is not constant. Sometimes they are producing or pumping a very large quantity, or discovering new sections where crude oil is found, and that they have much more crude oil coming in than they have going out, while at other times they may have more going out than coming in. The products of petroleum of course are produced more constantly, and consequently the production of naphtha is more constant. I presume that is what he meant in that paragraph.

MR. LANSDEN—Of course circumstances govern it all. I have been putting in machinery that cannot use crude oil, and I will tell you why. I figure that we will have naphtha of 68 gravity when we have no crude oil to be bought. Why do the companies refine crude oil? It is because it is worth more in the refined than in the crude state. While the various farmers and countrymen throughout the district are tapping or putting their wells down, I suppose some of the larger companies may want to reduce the price in order to get the farmers to sell out. They put the price down and the farmer has to sell—he cannot either manufacture or refine. I think this fluctuation is purely due to the speculation in the property. As I say, I have recommended my Company, and we are putting in, at a very heavy expense—did it four years ago, and are doing it again now—machinery that cannot use anything but the higher grades of oil, and I figure, on that one idea, we will have naphtha of a certain gravity when we will not have crude oil at all. One remark in the paper I take issue with, in regard to naphthaline. I believe Mr. Higgins states that by the use of naphtha we get rid of naphthaline.

MR. HIGGINS—That is the experience that has been coming to us from the different gas people.

MR. LANSDEN—I would like to get into that condition myself.

MR. HIGGINS—I presume some gas engineers present are able to explain that matter satisfactorily to Mr. Lansden. I have no doubt there are people here who have had the experience and know what it means, and I would be glad to hear from some of those gentlemen.

MR. R. YOUNG—My advice to all gas engineers who are going to build a water gas apparatus is to build an apparatus that is suitable for the use of crude oil. With the apparatus that I have—and I think it is applicable to all apparatus suitable for crude oil—you can use either. If you put in an apparatus suitable only for naphtha you cannot use crude oil, while with one suitable for crude oil you can use naphtha or oil, according to the situation. If you find that naphtha is cheaper than crude oil, use naphtha, and if you find that crude oil is cheaper than naphtha, use crude oil.

MR. W. L. BROWN—It seems that there is a question as to whether we will use naphtha or crude oil. I have read over the papers very carefully and have compiled some figures. I am very sorry that my experience will not allow me to make a comparison between crude oil and naphtha with the plant we have at present. I have a few figures of our earlier days of water gas, some taken when we had the Springer plant and some from the Pratt & Ryan plant, where naphtha was used entirely. As far as the figures are correct I will give them. In the Springer plant, during June, July and August, 1889, there was an average make of from 27,000 to 31,000 cubic feet. We used from 4.48 to 4.72 gallons to the thousand. I will go back and begin from October 1 to 20, 1888. In the crude oil, Springer plant, on an output of 14,295 feet, we used 5 gallons and 64.6 pounds of coke, which, however, was the gas house coke at that time. The next three months were on naphtha, and we used, on an output of from 14,000 to 28,000 feet a day, from 4.5 to 4.7 gallons of naphtha. We then went back to crude oil, and from December 28, 1888, and during January and February of 1889, on crude oil, we used from 4.4 to 5.2 gallons crude oil, the coke running from 56 to 63 pounds. That was also soft coke. We then went back to naphtha, and from that time to this we have used naphtha. I will say that during a portion of February, 1889, there was a daily average of about 18,000 feet, naphtha 4.69 gallons, and coke 53.4 pounds. In June, July and August, 1889, same plant, ran from 4.48 to 4.72 gallons of naphtha, while the coke went from 59 to 67 pounds. We then changed to the Pratt & Ryan plant, and, throwing out of consideration when both apparatus were used, we come to October, November and December, 1889: straight naphtha, 4.79 to 5.20 gallons, and 51 to 61 pounds of coke. I can now give you the figures for 1890. There was a total output of 15,545,000 cubic feet, with a daily average of 42,588 cubic feet. The range of coke, which was Connellsville coke, was from 41.7 to 52.3 pounds, the average being 46.7. The naphtha range was from 4.7 to 5.23; the average for the entire year being 4.94. For the year 1891, the total output was 19,602,000 cubic feet, with a daily average of 53,704. The coke ranged from 43 to 59.4 pounds, with an average of 47.5. The naphtha range was from 4.69 to 5.56 gallons, with an average of 5.04. For the first 4 months of 1892, on an output of 8,092,000 cubic feet, with a daily average of 68,876, the average coke was 42.6 pounds, and the average naphtha was 4.97 gallons. So that, taking the last 2½ to 3 years into consideration, I have found that our naphtha ranged from 4.94 to 5.04 gallons, and the coke from 42 to 45 pounds. This is on a candle power of 26 to 28, Jones photometer, so I can say in safety it ranged from 24 to 25. Therefore, I think it is very important that in Mr. Higgins' figures he should have stated some relation with regard to the output. Mr. Higgins makes some criticism in regard to the plants, stating that, "Some of them, however, are mere manufacturers of lampblack or tar, using extravagant quantities of the raw material and producing a small percentage of imperfectly unified or fixed gas." You might say that if we used that much coke or that much naphtha we do not get it all into gas, it goes somewhere else. Where does it go? It is simply lampblack or tar. We can make but one barrel of tar for every 5,000,000 of gas. If anybody can do that I would like to do it. We make no lampblack at all. The question I would like Mr. Higgins to answer is, on what basis of output he produces his figures.

THE PRESIDENT—Do you mean to say you make no lampblack or tar with the use of crude oil or naphtha?

MR. BROWN—With the use of naphtha—I only speak with regard to the last two years.

MR. HUMPHREYS—I would suggest there are other ways in which that lampblack residual can be used up. It can be deposited on the super heater bricks and burned up. You cannot assume that all your oil has gone into gas. I would suggest that in matters of this kind comparisons should be made very carefully on the same gas: and I do not think there is any engineer here who has had any wide experience with photometers that would dare to assume that the Jones jet (the photometer used by Mr. Brown) can be relied on. In the case where a Jones jet photometer is alone used I do not think one is in a position to make any true comparison as to results, and I think any such comparison in any one place would only demonstrate that that particular machinery—provided all the conditions were the same as to manipulation and careful management and everything worked to its best condition—that all, then, you would demonstrate would be that *particular machinery* was better adapted to one material than another. In regard to the variation in production of the naphtha, I do not see why Mr. Higgins in his reply has not furnished an argument against himself. If all crude oil does not contain the same amount of naphtha then certainly that is no reason why the production of naphtha will vary less than the crude oil. Mr. Somerville stated he thought we all would agree that, if crude and naphtha are compared, we will decide in favor of naphtha at practically the same prices. In other words, it is for us to decide how much more we will pay for naphtha than we will for crude. What we want is the ultimate balance sheet; we want to know how we will make the most money and show the best results in every way to our directors at the end of the year. I do not think it is a question of price in that way, as Mr. Somerville put it. It is of course a question of price, but not as stated by Mr. Somerville. I do not think, as Mr. Lansden says, that we ought now to use naphtha because ultimately we may be forced to use it. I think Mr. Young's position is the strong one—that of having an apparatus you can use with the crude oil, and so be able to use the crude or any of its products offered to you at the lowest price, and in that way not leave yourself entirely in the hands of the oil companies. I know our Company was forced into this position by the way in which the price of naphtha ran up on us. Not one of our superintendents the other day voted in favor of crude who was not opposed to it when first supplied to them, and those are the same men who have turned around and are saying, "For heaven's sake, don't change over to naphtha."

MR. A. S. MILLER—One of the first points that strikes me in this paper is this reference to Mr. Egner, which I understood him to say was made without his knowledge. The figures that are given are 83 cubic feet of 70-candle power gas per gallon of naphtha used—nearly twice as high as the figures that Mr. Egner gave before the Association last year. Turning to those figures, I find the best results were obtained from Lima crude. I do not understand why it should take 10 pounds more coke to gasify crude oil than naphtha. Mr. Glasgow took up that subject and made a very careful test. His figures were carefully made, and he showed beyond question, to anyone who will read that paper, which was delivered before the Savannah meeting of the American Association, that it took 8-tenths of a pound of carbon to gasify 5 gallons of crude oil. Now, the difference between 8-tenths of a pound of carbon and nothing is not very great, so that if it takes nothing to gasify naphtha I do not see where he gets the difference between 8-tenths and 10 pounds. It is not clear to me why it should take 10 pounds. Now, he gives some pretty high figures. This paper was sent to me last month in Omaha, and I took my last month's report, which is a pretty fair average. With 4.63 gallons of crude oil we got 27.8 candles on an average, or 6 candles to the gallon. Now, I do not know of any machinery that will do very much better than that, with naphtha or anything else; and we get back from our tar 2 cents to help pay for our oil. We use in doing that 33 pounds of soft coke, and our purification, cost of material and labor, is less than half a cent. I do not exactly understand what signifies the fluctuation of crude oil as long as it ranges below naphtha. Of course we would like to have it constant; but if naphtha is constant, and still above crude oil, I do not see why we should change to naphtha because it happens to be constant, provided that crude oil is cheaper; and, as two or three of the gentlemen have stated before, if we build a plant that will use crude oil there is no question about its using naphtha.

MR. EGNER—I want to answer Mr. Lansden in the attempt to help him in the instance of the naphthaline trouble spoken of. When I took charge of the gas works in St. Louis we had a great deal of naphthaline in the mains. I was asked to get rid of it if possible. We used naphtha, as I had been taught to do in New York, and we got rid of the naphthaline. Of course, with the advent of crude oil we tried it, as it was so much cheaper than naphtha; but we commenced to get the naphthaline back again. Then we used more naphtha, and got rid of the naphthaline. That was done several times. The Secretary of the Company, Mr. Thompson, thought crude oil was economical, and advised its use. We got rid of the naphtha we had on hand and got more crude oil, but every time we got more naphthaline. Our results, as obtained, are published in the *American Gas Light Journal* for May 2, 1888, p. 295, and if any of the gentlemen have files of the paper they can look it up and see just what we did. I think it is hardly fair to criticise Mr. Higgins' paper, as some of the gentlemen have done. He is an oil man, as I remarked before, and not a gas man, and so gets his information from a number of gas men who perhaps are not so able as some of the gentlemen criticising the paper, and that has misled him. But as to the fact of ridding the street mains of the naphthaline, Mr. Higgins is correct.

MR. LANSDEN—I do not want you to have the impression that I am alone in this matter. I believe there are ten or fifteen large works in the United States putting in machinery to answer the purpose of the same machinery I am putting in now. I think most of them are doing it, and spending the money, with the idea that they will have naphtha to make gas from when they will not have crude oil.

THE PRESIDENT—I think from the way Mr. Lansden put the naphthaline question a short time ago, he has been troubled with naphthaline in making water gas from naphtha. Is that so?

MR. LANSDEN—Yes, that is the experience of a good many.

THE PRESIDENT—I would answer myself to this extent. I have had experience with perhaps five or six water gas plants. We had one at one time using naphtha only, which made naphthaline about as fast as it made gas. But we have been using our present plant, which uses naphtha altogether for over a year, and we have not yet found the first trace of naphthaline. I think it comes wholly from having a very uneven heat in that part of the apparatus which turns the naphtha into gas, a portion of it being heated much higher than necessary. Mr. Young, I think you failed to state whether you are using oil or naphtha at the present time.

MR. R. YOUNG—We are using naphtha at the present time; but coming back to the question of naphthaline. This has been a subject for discussion ever since I became connected with the gas business, and I am sorry to admit that I am about as ignorant to-day as to the cause of its production as I was thirty years ago. When I put in our first water gas plant, I made up my mind that now I had mastered naphthaline, and that there would be no more trouble with it, and during the first three or four years that I was using water gas I never saw any naphthaline. I thought that was due, of course, to the use of water gas and using naphtha; but the fourth year I was using it, in the fall of the year, I had an attack of naphthaline such as I almost never had before—using the same apparatus and using the same gravity of oil, and I am unable to arrive at the cause. I worked away for about a week or so, and it disappeared, but in the spring it came back as usual; and such was the case until I put in a new apparatus. When I started up the new apparatus I first used crude oil and had no trouble with naphthaline. We went back to naphtha; it appeared again, not because we had any difficulty from using crude oil. Of course we are prejudiced in the city to the odor arising from crude oil; we fear that the people may complain about it; but the price of crude went up and the price of naphtha came down to such an extent that we desired to use the latter. We also had some difficulty in getting the crude, but we could get the naphtha two days after ordering it. We could not wish to work any better. I would like to ask some of the gentlemen here if they could tell me if there is any difference in the gravity of gas made from crude oil or that made from 70° benzine or naphtha? From the fact, when I was using the crude, that on some days I had a good deal of complaint of want of gas, I concluded that the gas made from crude oil had a higher specific gravity than gas made from naphtha, and as soon as I went back to the use of naphtha I had no more trouble. I would like to know if any engineer has taken the trouble to test the gravity between the gases made from the different oils. I did not think of it until it was too late.

MR. HUMPHREYS—I would state in answer to the last question that in looking over our reports no such variation has attracted my attention.

MR. R. YOUNG—I thought this, that perhaps the pipes were just doing about the maximum amount of work, and the little difference in specific gravity might produce that result.

MR. A. S. MILLER—I would like to state that I have made naphthaline and lampblack about as much as the rest of us here, and that I made naphthaline and lampback out of naphtha and out of crude oil. I have been running with crude oil for over two years without a trace of either naphthaline or lampblack, but on a couple of hours notice I can make just as much as the most of you would like to have. It is a very easy thing to make and a very easy thing to keep from making. I will say that I have seen traces of lampblack, though not enough to bother us in any way, and have not seen a trace of naphthaline.

THE PRESIDENT—Perhaps you would explain.

MR. A. S. MILLER—It is by increasing the heat, say, to 2,000° or perhaps a few hundred higher.

THE PRESIDENT—In increasing the heat in the superheater and in the furnace?

Mr. A. S. Miller—Not in the cupola, but in the superheater, and the heating of the oil very high and heating it suddenly.

Mr. Geo. Treadway Thompson—The discussion hitherto has been altogether as to the comparative uses of naphtha and crude oil in the manufacture of gas. Since Mr. Higgins has made a reference to the use of naphtha in the *retort* process, it seems proper that something should be said in regard to that. In the use of crude oil in retorts for enriching coal gas it has been my experience that one scurfer is necessary for every oil retort, while with the use of naphtha, with careful handling, one-half of the time for one retort is all that is necessary for scurfing where you are employing four retorts in making oil gas continuously.

Mr. R. Young—In using crude oil there is an excess of carbon that we have to get rid of in some way. We have either got to take it down as tar or lampback, either one or the other, and the proper course is to keep the heat so as to produce the tar. As Mr. Miller says, you have got a very narrow line to walk on. You may either fall to one side or the other, but it is better to fall to the side that makes the tar; there are better results from it.

Mr. Faben—I will contribute my little might. I have had some experience in the manufacture of gas from naphtha and crude oil. Our first experience was in enriching coal gas with the residuum that was made many years ago—in the late sixties or the early seventies. We afterward used crude oil (Pennsylvania oil), and afterward crude naphtha. There was a disadvantage in using crude naphtha on account of its containing gasoline, naphtha, benzine, coal oil, and clear down through to paraffine—all sorts; and I was induced to try a fractionated naphtha, a naphtha made almost entirely of 63 gravity stock. We certainly were benefited by it. We learned long ago that to make oil gas it was necessary to have a long time exposure to a moderate heat, and not a short time exposure to intense heat, and we also learned that we could not make water gas and oil gas in the same retort at the same time. We put up a water gas plant and used crude oil. I had the same difficulty with crude oil that I had with crude naphtha. It has been stated here that the tar from crude oil was worth in market somewhere about 4 cents a gallon. I could not get any 4 cents a gallon, and I am offered only about 2½ cents for tar from naphtha. Several factors, one of them quite prominent, have been left out of the discussion. That one is the quality of the service rendered. There are companies in the United States who in practice calculate that the dollar and cent basis on the balance sheet is all there is to the business, and there are others that take into account the quality of the service rendered. The slight difference between the cost of naphtha and crude oil might be offset by the quality of the service rendered.

Mr. Egner—We have all listened to a very interesting paper, Mr.

President, and I move that we extend a hearty vote of thanks to Mr. Higgins. (Adopted.)

THE PRESIDENT—If there is not to be any further discussion on this paper, I would call attention to the fact that one or two questions in the Question Box refer to this subject. They are numbered V., VI. and XII. No. XII. is as follows:

"*In the manufacture of water gas, which is the cheaper material, crude oil at 2 cents per gallon or gas naphtha at 4 cents?*"

It hardly seems necessary to ask for an answer to that question, but if anyone desires to say anything about it we are ready to hear about it now.

MR. SOMERVILLE—I would say that it all depends on the apparatus we are using.

THE PRESIDENT—No V. is:

"*In making water gas by the cupola system, can 30-candle gas be made as economically as 20?*"

MR. YOUNG—What does that mean?

THE PRESIDENT—It means what it says; can it be made at the same price as 20-candle power.

MR. HUMPHREYS—I would say it could be made as economically, and that the relative cost would be less.

THE PRESIDENT—No. VI. is:

"*In carbureting gas with oil burned in retorts, how can the oil supply be regulated to the heats so as to produce the best results?*"

MR. LANSDEN—I would suggest that somebody regulate the valve.

THE PRESIDENT—I suppose the questioner wants to know how to regulate the valve.

MR. LANSDEN—By constant attention to it.

MR. EGNER—I would say we used to have no trouble with that at all; we regulate it by the color of the retort.

MR. STRATTON—I think that is purely a matter of experiment more than anything else. The operator would have to determine the color; it is all learned by experience.

MR. SOMERVILLE—I believe it has been a custom to fix a test cock on the lid of the retort, and letting the gas blow on a clean sheet of paper. If the paper showed no signs of discoloration then he was using too little oil for the heat—in other words, began to produce lampblack; but if the paper showed signs of discoloration probably he had about the right heat and the proper amount of oil was going in.

MR. R. YOUNG—In reference to what Mr. Somerville says, the color of the paper would show that the heat was too low; but if it did not color would it be any guide as to the heat being too high and decomposing all of the oil? Would it be any assurance that the heat was not too high if it did not color; would that then prove that the heat was right?

Mr. Somerville—I think you would very soon see, by opening the door, what the gas was doing. You would see immediately that you were producing lampblack. I believe that the proper test is to have a slight discoloration of the paper.

Mr. R. Young—Does Mr. Somerville think that decomposing the oil in the retorts is a good way of enriching gas? While it will increase the illuminating power, will it give a good light without smoking?

The President—In one way.

Mr. Gwynn—Respecting what Mr. Somerville said in making oil gas by the retort system, I have made a great deal of oil gas, and I have made it where it was not used as an enricher for coal gas. I found in using crude oil or naphtha that the best way was to obtain a straw color. You will find if you get the straw color you will make from 80 to 85 feet of clear oil gas to the gallon, and you will have very little tar or lampblack, if you follow this instruction.

The President—That seems to be an answer to the question. We will now listen to a paper by Mr. Walter Lee Brown, of Evanston, Ill., entitled,

NEW FEATURES IN ROUTINE OFFICE WORK OF SMALL GAS COMPANIES.

It will be the most logical plan to preface this paper with an outline sketch of the methods we pursue in taking meter statements, and in the preparation and collection of the resultant gas bills. The meter reader starts out with his small "Meter Statement Book," and pad of "slips," as we term them, and sufficient matches. After the reading of the meter, the inspector writes on one of the slips the name of the householder, the month, the number of thousands cubic feet of gas used, and the gross amount of the bill (which, in our case, since our gross price is $2 per one thousand feet, is the product of a multiplication by two, hence easily and quickly done), and leaves the slip in the kitchen as he passes out. At the same time he enters in the statement book the last reading and the number of feet of gas consumed.

At convenient intervals the meter books are returned to the office, where the bills are made out and *retained*. This is where our practice differs from that obtaining in Chicago and elsewhere, in that we do not have to send out a second corps of men to distribute the bills, for the latter are paid at our office, while the slip shows that the statement *has* been taken and serves as a memorandum to jog the memory. If the consumer brings his slip to the office on or before the 10th (or if he appears without it, for that matter), he is entitled to 25 per cent. discount, quickly ascertained by dividing by four and subtracting; whereas, if he comes after the 10th, his bill is the gross amount shown on the slip. This plan of collecting—for which credit is due to the previous management of this Company—is much more convenient to us than the contra plan of outside collecting from house to house and store to store, in use by many small companies. None ever object to paying at our window, and as a result of our peculiar location as a suburb of a large city, many of our consumers are Chicago business men; consequently, about one-quarter of our bills are paid in checks, which is convenient, obviates errors, and tends to prevent unnecessary "kicks;" for while a consumer might frequently expostulate verbally, he will seldom go to the trouble, or may lack the time, to put his grievances in writing.

The elaboration of the details of the above system will constitute the body of these notes.

First—"*The Meter Statement Book*" The form we use is shown in Exhibit "A."

NORTHWESTERN GAS LIGHT & COKE CO.

No. Street.	Name of Consumer.	Folio.	No. Me	Size	Jan.	Feb.	Mar.	Apr.	May.	June.

Exhibit "A."

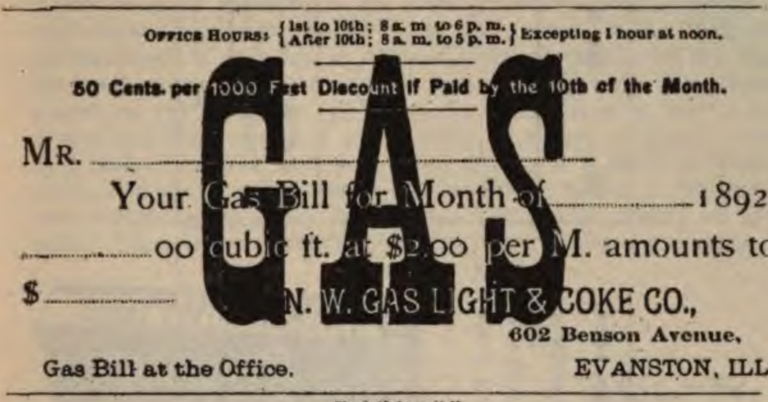
It is a combination of the form previously used by this Company with that described in the paper, entitled, "Points on the Management of Small Coal Gas Works," by Mr. L. P. Gerould, and read at the Cincinnati meeting, in May, 1889, and shown here as Exhibit "B." In one respect we think our modification better than Mr. Gerould's form, namely, that we divide the month column in two, the space to the left containing the reading, that to the right the number of feet of gas used. The advantage is that the footings of the amounts of gas consumed can be conveniently obtained by our plan; whereas, in Mr. Gerould's form this cannot be done unless he gives up *two lines* to every meter, and carries out to the right his results. And from a reading of Mr. Gerould's paper, I should judge he does this. A convenient number of lines to the page is 40, and the book is divided into successive groups of a number of pages for the first six months of the year, followed by the same number of pages for the latter half of the year, and thereafter alternating.

MENDOTA GAS WORKS. INDEX.

No. Street.	Name of Consumer.	Folio.	No. Me.	Size	Jan. 1	Feb. 1	Mar. 1	Apr. 1	May 1	June 1

Exhibit "B."

Second—Our Memorandum Slips. Shown in Exhibit "C," ("Gas in large red letters.")



Office Hours: { 1st to 10th; 8 a. m. to 6 p. m. / After 10th; 8 a. m. to 5 p. m. } Excepting 1 hour at noon.

50 Cents. per 1000 Feet Discount if Paid by the 10th of the Month.

GAS

Mr. ....

Your Gas Bill for Month of 1892,

.... 00 cubic ft. at $2.00 per M. amounts to

$ ....

N. W. GAS LIGHT & COKE CO.,
602 Benson Avenue,
EVANSTON, ILL.

Gas Bill at the Office.

Exhibit "C."

The history of the various experiments we tried until we settled on the present form is interesting. The original form employed was about the same as the one shown, save in the absence of the red lettering. It was not quite satisfactory, however, as people complained that it was so insignificant that it was easily lost, misplaced or destroyed. So we started in to make it more conspicuous. First we tried printing it on *pink* paper (of which I am pleased to show you an example) which worked for a time, until our consumers began to bring in *coal slips* which happened to be printed upon the same color and tint of paper. Then we sought for a "notorious" color and endeavored to be fashionable with a terra-cotta shade (a sample of which is herewith exhibited). But still the slips were not conspicuous enough, and so we went back to the plain white and printed the word "Gas" in small red letters over the front only. Finally we changed to the largest convenient size of surchage and imprinted it on *both* sides of the paper, so that whichever side was uppermost, the word "Gas" stared the unfortunate householder full in the face, and the problem was solved. The size of the slip is 3¼ × 6 inches.

Third—Preparation of the Gas Bill. The form of bill we use is illustrated in Exhibit "D." The size is 3⅜ × 10½ inches and the print is in black upon *yellow* paper. It is the general style of coupon bill (with modifications) used wherever the Felt & Tarrant coupon cutter is employed.

While the meter takers are out on their rounds the bills are gotten ready. The first step is the impression of the consumer's name. With us, a name is rarely *written*; we use only the rubber stamp, and the application of this useful little implement is one of *the* features of

No Discount Allowed After the **10th** of the Month.

EVANSTON, ILL., DECEMBER 31, 1891.

Mr...

To **Northwestern Gas Light & Coke Co.,** Dr.

602 BENSON AVENUE.

State of Meter at this Date.............00

State of Meter at last Date.............00

Date of Payment.

OFFICE HOURS

From 1st to 10th.
8 A. M. to 6 P. M.

After 10th of Month
8 A. M. to 5 P. M.

To Consumption of..................00 *Cubic Feet of Gas @ $2.00,* $....................

Less Discount (of 50 cents per 1000 Cubic Feet) *if paid on or before* **10th** *of Month,* $....................

Failure to Receive this Bill Does Not
Entitle Consumer to the Discount.

Net, $....................

Folio............... **DEC. 31, 1891.**

Bill @ $2.00, ...

Discount, ...

Net, ...

Exhibit "D."

our system. Every consumer has a stamp, so that we have at present about 750 stamps. These are arranged in drawers in a cabinet, and in the order of following in the meter statement book. Moreover, each drawer represents *exactly* two or three pages of the book, and on the outside of each drawer is a label giving the number of the book, the numbers of the pages covered thus: "II-6-7-8." The drawer spaces are $17\frac{3}{4}$ inches by $15\frac{3}{4}$ inches, by $1\frac{1}{2}$ inches deep, and in each drawer is a movable slatted tray, having 15 spaces, each $2\frac{5}{16}$ inches by $\frac{5}{8}$ inches. In the bottom of each drawer is a sheet of blotting paper, moistened with glycerine, to prevent the rubber of the stamps from becoming hard, the latter, when not in use, resting on these pads. There are sufficient spaces left in each drawer for changes.

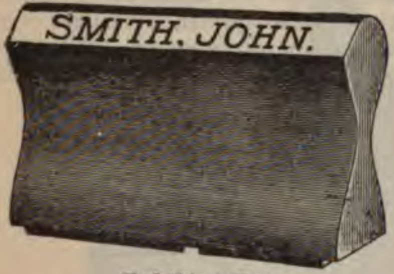


Exhibit "E."

360-R.

SMITH, JOHN.

Exhibit "F."

The stamp is of the peculiar shape given as Exhibit "E," is 2 inches long by $1\frac{3}{8}$ inches high, and $\frac{1}{2}$ inch through the thickest part. A section is sawed off the front of the top at an angle, and on this space is affixed the name indicated by the stamp. The appearance of the stamped impression is shown in Exhibit "F." We find it more convenient in running over the bills to give the surname first. The number above is the folio page and R (or L) the right or left side. When the bills are to be stamped, we take out the first drawer and stamp each bill twice—once on the body of the bill and again on the coupon, and since we have about 100 duplicate bills to make out to send to those who have especially requested it, it necessitates *four* applications of some of the stamps. We stamp in regular rotation, both as concerns each drawer and the succession of drawers. The gain in time of stamping over writing is very considerable. We can stamp the 1,700 impressions leisurely in $1\frac{1}{2}$ hours, and inside of *one hour* if necessary. The swiftest of writers could not keep pace with this. Further advantages are the relieving of one of the most monotonous features of gas office routine, namely, the writing of names, and a bill is found easier when the name is printed than when in writing. We made the change from the old system of receipting a bill, to the coupon cutter and rubber stamp systems at the same time, otherwise the use of the cutter alone would compel every name to be written twice at least, the folio number to be on the coupon. By our system the name and folio number are on *both* the bill and coupon, which has many times proved to be an advantage.

The bills are next to be written up from the meter books, and there can be no time saved in this. The last and present readings and number of feet used are written down as usual, but there we stop. After all these figures have been added to the bills, comes the stamping of the gross, discount and net amounts. Here again we do no writing, hence have no calculations to make—the rubber stamp does it all in *one operation*. We have a series of stamps for about all the combinations we are likely to need for a long time. Their number is 120, and they range from 15 cents to $18 net. Being a small concern, having no factories or theaters, and but two hotels, there remain only the churches and a few clubs and private residences that use over $18 per month, and these few amounts are easily written. The appearance of the stamp is shown as Exhibit "G." The shape of the stamp is similar to that for the name; in size it is $\frac{3}{4}$ inch long by $1\frac{3}{8}$ inches high, and $\frac{13}{16}$ inch thick at the bottom. The top is planed, as was its mate, and on the planed portion is written the number of feet of gas represented by the stamp less the two lower ciphers; thus the one illustrated covers 12,000 feet. The impression of the stamp is shown as Exhibit "H." These 120 stamps are in one drawer of the before-mentioned cabinet. The stamping of the values takes no longer time than that of the names, and occupies on an average about *one-tenth* as long as it does to write them out, which means to multiply by two, write the product, divide (mentally) by four, write the quotient, subtract the latter, write the result, finally checking by use of a prepared table. The saving of time and of errors and of unnecessary work is a desideratum gained. It will be noted that the net price is in figures of a larger type than the gross and discount figures; this was done advisedly to train the eye of the consumer to seek naturally the net price. All of the rubber stamp drawers are kept in a specially designed cabinet, capable of accommodating about 1,200 names.

Exhibit "G."

24.00
6.00

18.00

Exhibit "H."

To make our method absolutely plain to all, I repeat this much: That our bills are made out in *three* operations, each distinct and complete in itself. First, the names are stamped in rotation; then the meter readings and amounts of gas used are written down, one after the other; finally, the gross, discount and net amounts are stamped, in the same order as the previous operations, and the bills are ready for distribution in the alphabetical pigeon-holes of the case by our window.

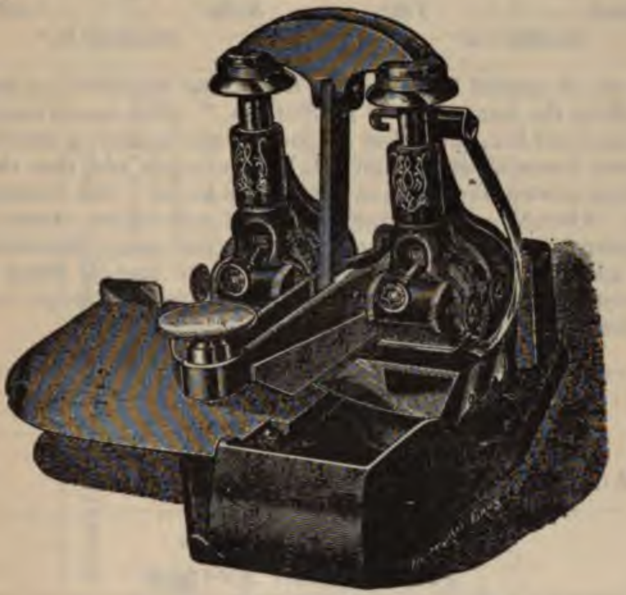


Exhibit "I."

Fourth—Payment of the Gas Bill. When one of the duplicate bills sent out is received, either by mail or at the window, and possibly accompanied by the slip, or when the slip alone is presented, the original bill is placed between the jaws of the Felt & Tarrant coupon cutter, illustrated in Exhibit "I," and the lever depressed vigorously, whereby the bill is receipted, and the coupon stamped with same date of payment and dropped into the drawer beneath, and all by one motion. At the end of the day the coupons are added on the blotter, the cash counted and a balance sought. When we are either "ahead" or "short" on the balance, an examination of the slips, which are filed and always preserved until the next month, frequently reveals the cause of the discrepancy. The names on the coupons also aid in such searches. Instead of keeping memorandum lists of duplicate bills sent out, we have found it works better to keep the actual original bill itself in the pigeon-holes. Then, when the duplicate is paid, the original is destroyed. On the original, in the rectangular space at bottom, is stamped the form shown in Exhibit "J," and the date filled in. At the 15th of each month we send out statements of all unpaid bills, and this fact is also impressed on the original bill by the form given as Exhibit "K." The appearance, then, of a receipted bill, with all of its possible accompanying inscriptions, is shown herewith as Exhibit "L." We might add that the payments are posted directly from the coupon to our "Gas Consumption Book," whereby a daily cash book, and consequent entries of the consumers' names are unnecessary. For our own convenience, we write upon the coupon the last reading, at the time of filling in the statements on the bill, so that when we post into the ledger we have both readings to check up the amounts of gas used.

DUPLICATE.

Sent .... *189*....

Exhibit "J."

Statement.

Sent .... *189*....

Exhibit "K."

Van Buren, E R.,

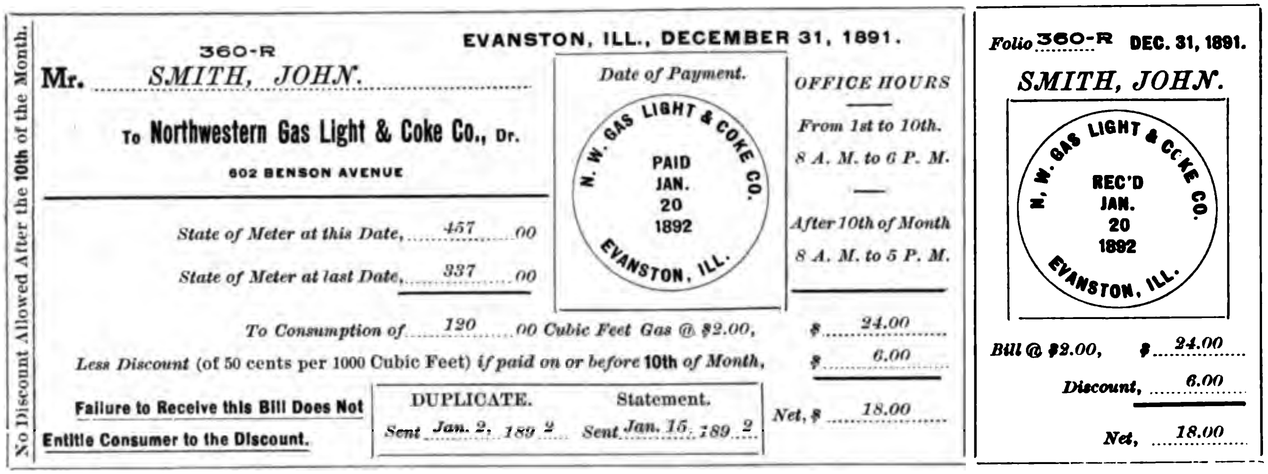
No. 303 Benson Avenue

PAGE NUMBER IN METER-TAKING BOOK.	
1	14

Gas Consumption Book
Page No.
380-R.

Exhibit "M."

Fifth—Consumers' Directory Card. This idea, exemplified in Exhibit "M," has proven in use almost indispensable. The advantages of a consumers' directory are obvious. The advantages of a card directory over any blank book, however well indexed, are almost



No Discount Allowed After the **10th** of the Month.

360-R

EVANSTON, ILL., DECEMBER 31, 1891.

Mr. *SMITH, JOHN.*

To **Northwestern Gas Light & Coke Co.,** Dr.

602 BENSON AVENUE

State of Meter at this Date, 457 00

State of Meter at last Date, 337 00

Date of Payment.

N. W. GAS LIGHT & COKE CO.
PAID
JAN.
20
1892
EVANSTON, ILL.

OFFICE HOURS

From 1st to 10th.
8 A. M. to 6 P. M.

After 10th of Month
8 A. M. to 5 P. M.

To Consumption of 120 00 *Cubic Feet Gas @ $2.00,* $ 24.00

Less Discount (of 50 cents per 1000 Cubic Feet) *if paid on or before* **10th** *of Month,* $ 6.00

Failure to Receive this Bill Does Not Entitle Consumer to the Discount.

DUPLICATE.	Statement.
Sent Jan. 2, 189 2	*Sent* Jan. 15, 189 2

Net, $ 18.00

Folio 360-R **DEC. 31, 1891.**

SMITH, JOHN.

N. W. GAS LIGHT & COKE CO.
REC'D
JAN.
20
1892
EVANSTON, ILL.

Bill @ $2.00, $ 24.00

Discount, 6.00

Net, 18.00

Exhibit "L."

equally obvious. A book becomes filled with names of those who have ceased to be consumers; the card directory preserves only the present ones. The book can never keep the names in alphabetical order under each initial; the card directory can and does. These cards also give the references to the "Meter Statement" and "Gas Consumption" books, and we are constantly making use of such references.

In conclusion I must apologize to you for the degree to which this paper has been extended, but I firmly believe that the more minutely the details of any successful scheme are presented, the more time it will allow the recipients of such information to work out their improvements, in this case all tending to the more perfect development of the profession we labor in.

DISCUSSION.

THE PRESIDENT—Gentlemen, you have listened to a very excellent paper by Mr. Brown, and I presume this will be very generally discussed. It certainly seems as if the forms he has presented would be very useful to many gas companies.

MR. GEO. TREADWAY THOMPSON—The paper just read presents many valuable points, most of which will prove quite novel to many of us. Mr. Brown refers in his title to the office work of *small* gas companies, but the use of the coupon cutter, the consumers' card directory, and doubtless also the stamps for amounts of bills—gross, discount and net—might with advantage be adopted by companies of even the largest size. I question, however, if in large offices, where each bookkeeper has some 2,500 accounts, the use of consumers' name stamps would pay, or the system of retaining bills be convenient. Freedom from trouble with the Exhibit "C" memorandum slips is too dependent upon the accuracy of register men; and with a rate less easy of figuring than the $2 and 25 per cent. discount, much difficulty would be met. In the bill shown in Exhibit "L," for what amount has Mr. Brown receipted? Did John Smith get his discount on the 20th?

MR. BUTTERWORTH—As Mr. Thompson has probably had some experience with the Felt & Tarrant coupon cutter, I would like to ask him whether he does not often find it difficult to use it to advantage on the heaviest pay days at the office because of the fact that the bills are apt to be handed in to them all crumpled and wrinkled. That has been our experience with them. Women bring in their bills in their pocket-books, for instance, all folded and wrinkled, and it requires considerable time to smooth out in shape to be inserted into the machine.

MR. BROWN—I would like to answer the question by saying that the peculiarity of our way of doing it is that we keep the bill there. I can state further that there is no difficulty with this system, and parts of it at least would be valuable to every gas company. I have been very particular in using the word small, and I think myself that possibly the rubber stamp system would be cumbersome in very large offices.

Mr. Thompson—There may be some difficulty in the case of a bill being folded. The tellers may, however, refuse to receive those bills, when there are a lot of people about the pay window. The bills must be straightened out before they can be put into the coupon cutter. If they are very much crumpled all that is necessary is to straighten them lengthwise across the center, then slip them in and cut the coupons off. We have handled as many as 8,000 people in one day in our office, with four of these cutters; the bulk of the people being handled by two tellers.

On motion of Mr. Somerville a vote of thanks was tendered to Mr. Brown.

The President announced that the next paper to be read was that contributed by Mr. William A. Stedman, Jr., of St. Louis, Mo. As Mr. Stedman was unable to be present at the meeting, the President called upon Mr. G. T. Thompson, of St. Louis, to read the Stedman paper, which was as follows:

EVERYDAY GAS ANALYSIS.

It is popular belief that regular and valuable methods of gas analysis are beyond the capacity of most gas engineers. The only requirements, however, for a mode of analysis that shall enable any one to know what his purifying house is doing, and in a large measure to explain the dark mysteries of his photometer, are a few cheap absorbents, and some suitable form of measuring apparatus. With two or three graduated tubes of such a shape as to allow of their being readily carried from place to place, and by use of a small bore rubber hose, a connection can be made to any tap about the works, one or more samples of gas taken, conveyed to the place where they are to be examined, and an analysis made in a few moments.

One of the most convenient forms of measuring tubes is of this shape (Fig. 1), graduated on the long leg into decimal parts of the whole volume of the tube, the ratio between the bulbs and legs varying with the percentages in the whole volume of the constituents to be measured. Thus, for gas containing only a small percentage of sulphureted hydrogen and carbonic acid, which are about all the impurities the coal gas man cares to discover, a tube in which the bulb represents 900, and the leg 100 parts in 1,000, with 100 subdivisions on the leg, offers an accurate means of ready estimation of those gases. With water gas or producer gas, where the volume of carbonic acid, or carbon monoxide, is greater than 10 per cent., a tube carrying a smaller bulb, and consequently a larger percentage capacity in the leg is required. Such different tubes are called 10, 25, or 50 per cent. tubes, according to their graduation; those which form the basis of this article being 21 inches long (the bulbs ranging in diameter from $1\frac{1}{5}$ to $1\frac{3}{4}$ inches, and the legs being $\frac{5}{8}$ of an inch, external measurement), and cost $2.75 apiece. The few absorbents necessary can be procured at any drug store, and do not demand for their use any theoretical knowledge of chemistry. A moderately strong solution of caustic potash and some commercial arsenic are all that are required for ordinary coal gas analysis, while the addition of some subchloride of copper, hydrochloric acid, and pyrogallate of potash will make up a laboratory the scope of which will be a surprise to the possessor.

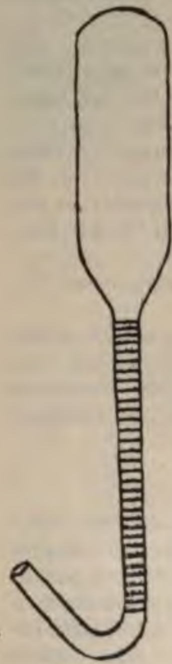


FIG. 1.

To explain the manipulation of fhe measuring tubes and absorbents, suppose a connection to be made at the inlet to a center seal, through a $\frac{1}{4}$-inch tap, nipple and lamp-cock, with a pice of rubber hose wetted so as to be readily inserted into the measuring tube throughout its length; the cock is opened, and gas is allowed to blow into the tube for five minutes, or long enough to displace all the air previously contained. Now the hose is slowly withdrawn, and as its end emerges from the bend of the tube, the latter is closed with the thumb, or a rubber cork, the cock is shut off, and the tube full of gas is carried into the laboratory, where it is sealed by withdrawing the stopper under water. It is well to

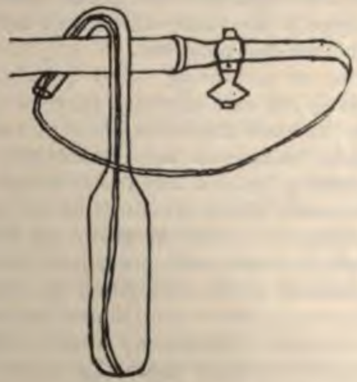


FIG. 2

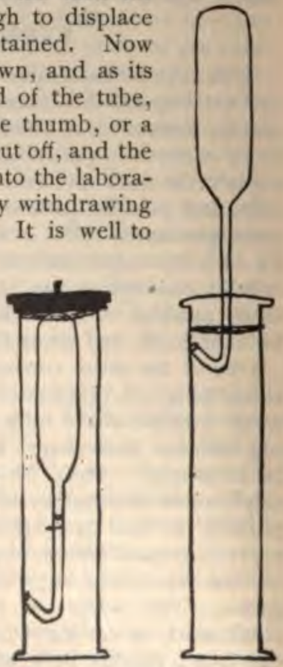


FIG. 3.

have a rack or rest, in which the tube may be placed in an upright position, on its bend as a base, while the absorbents are being applied. (See Fig. 2.)

To guard against variations of temperature and pressure, the tube should be immersed in a tall glass jar, of about 4 inches diameter, nearly filled with water, and fitted with a weighted cover to keep the tube completely under water. Such a jar will afford a constant temperature, while by taking the reading on the leg of the tube at the coincidence of the water level within the tube with that within the jar, equally constant pressure is obtained. (See Fig. 3.)

It is not necessary, for rapid calculation, to start with exactly 1,000 measures of gas for the difference in actual percentage of two estimates, one being 15 parts in 1,000 and the other 15 parts in say 960, will be so small that it may be disregarded.

Having read the measure of the sample of the gas to be tested, the tube is placed in the rack, the water is drawn off the short leg by a pipette, and replaced by the absorbent first required. Then the short leg is closed with the thumb, care being taken to exclude all air; the tube is inverted, shaken gently for half a minute, when it is slowly brought back to an upright position so that there are no bubbles left in the short leg, and the thumb is withdrawn under the water, which rushes into the tube to replace the gas absorbed. Now a reading is again taken in the temperature jar, the observed contraction being the measure of the gas absorbed. The constituents further to be sought for are treated and measured in the same manner, until all which are required have been determined. The tube is finally washed with water precisely as it was filled with gas, and since all gases to be examined will be saturated with water vapor, it is not imperative that the tube should be dried before another analysis is made.

The chief gases to be sought for, and their respective absorbents, are as follows:

In Coal Gas.—1. Sulphureted hydrogen. Absorbent used—a solution of arsenic in water.

2. Carbonic acid gas. Absorbent used—a solution of caustic potash in water.

In Water Gas.—Those mentioned under coal gas in their order, and—

3. Carbon monoxide. Absorbent used—a solution of cuprous chloride in hydrochloric acid.

4. Oxygen. Absorbent used—solution of pyrogallate of potash in water.

In producer gas, carbonic acid and carbon monoxide are treated in the order named. It is to be noted that in the estimation of carbon monoxide by cuprous chloride, an addition of caustic potash is needed to absorb the hydrochloric acid gas which is given off.

The determination of "illuminants" and hydrogen and nitrogen is not essential to the engineer, and may well be left to those equipped with large laboratories and a large amount of trusting faith.

The simplicity of the foregoing method of analysis renders it an object of easy daily observation, which faithfully pursued will teach its votary many lessons in cause and effect, and enable him to bring his candle-power and yield to almost friendly terms with one another.

DISCUSSION.

The President—Gentlemen, this subject is before you for discussion.

Mr. Miller—In handling apparatus of the kind illustrated in the paper, of course we have to be very careful to always keep the thumb exactly right. In case the thumb were not in the best of working order, and a little of this potash were to get into a slight cut or scratch, it would not be very comfortable. Another thing, this is always measured when the bulb is wet. As far as I can understand, he keeps it immersed in water and raises it when reading the volume of gas. Any variation in temperature or a draught in the room, unless you can use it in a room where there is no draught, would produce a very great variation in volume, and where you have gas with only a few degrees variation of temperature, it will make some very remarkable results.

Mr. Geo. Treadway Thompson—In the case of the measurements, you understand they are all made in the water. Now, the temperature of that water and the temperature of the jar will not vary. The measurements are not made with the graded tube exposed to the air; they are altogether made under water.

Mr. Miller—I did not quite understand from the reading of the paper that the measurements were made under water. I understood that this bulb was kept under the water and then, when the measurements were made, it was raised out of the water, leaving only the neck under water. That would leave the bulb subject to the surrounding draughts and to very rapid evaporation. This wet surface would be subject to very rapid evaporation, and any variation in draught would produce a very great variation in temperature.

Mr. G. T. Thompson—In the first place, the measurements are usually made in a room, and, in the second place, in raising your bulb from the temperature of the jar, raise it to where you want it, and it is only necessary to hold it poised there for the fraction of a second, and there will then not be difference enough to make any practical effect in the measurement of the gases considered in this paper.

Mr. Bredel—I would say that the sequence of analysis for carbon monoxide and oxygen ought to be reversed. The oxygen ought to be absorbed first, otherwise the vaporous oxide solution will absorb the oxygen. I do not see any other mistake in the entire paper, or anything to improve upon.

Mr. Chollar—In answer to the remarks of Mr. Miller I would say that almost anybody's thumb will stop the end of the tube all right. There is no trouble with it in reading off the volumes. If there should be any error by expansion, a person will see it. There is no difficulty with the experiments, and the small instrument is worth a great deal more than the reputation it has got in the books. It is written down as being inaccurate and not at all reliable, but if one will use it with a little care he will find that for ordinary purposes it is quite as good as the most elaborate apparatus for ordinary purposes, and convenient. Mr. Bredel speaks about the order of taking out the different parts. The oxygen should have been removed first and the carbon monoxide afterward.

Mr. Young—The greatest error I see in regard to the expansion would be in taking the bulb in the fingers. That of course would change the temperature.

Mr. Chollar—Take it below the neck; or, you could use a clothes-pin.

Mr. Young—It absorbs heat very rapidly and you must move very quickly with it.

Mr. Chollar—You are looking at it, and if there is any movement you can see it.

Mr. Young—Touching it with the hand would change the temperature.

Mr. Chollar—The graduation is very fine and if the gas is expanding you can see it moving; but there is no trouble with it.

Mr. Geo. Treadway Thompson—I was very much in hopes that Mr. Stedman would be present here, not only to read his paper but to make a demonstration of it.

Mr. Somerville—I was just going to say that the young gentleman—I suppose he is the son of the father whom we all know and respect—deserves great credit for his excellent paper; and it would be a good thing if the younger members of the Association would follow his example. He says at the close that it would "enable him to bring his candle power and yield to almost friendly terms with one another." I would suggest to him that if he tries the specific gravity of the gas, which operation is very simple and easily done, he and others will find that also a great help in bringing the yield and candle power together.

Mr. Chollar—The apparatus is accurate to this extent in my experience, that with the different samples, that are of the same quality, not varying, the determination of sulphureted hydrogen will be so near alike that you can not tell the difference from one to the other. There is possibly a little error on account of the absorption of a very small quantity of sulphureted hydrogen in the water, but that is easily determined. The correction for that is from 3 to 5 per cent. of the amount of impurity in the gas. When you have 1 per cent. of sulphureted hydrogen in the gas, if you allow one part in a thousand in addition to what you have determined, you would be correct if you wanted to be very particular, but in practical work in the determination of sulphureted hydrogen it does not make a particle of difference whether it is 9½ or 10 parts in a thousand. The apparatus is as good as any. I would like to say that in the determination of oxygen in air the books state that an average specimen of air contains 20.7 per cent. of oxygen. We have often determined it in the air and got 20.60. The tube is accurate enough for practical purposes.

On motion of Mr. Howard a vote of thanks was extended to Mr. Stedman for his excellent paper.

THE QUESTION BOX.

MR. JENKINS—As Mr. Odiorne is not here, I would suggest that rather than take up any other paper this afternoon we devote part of the time to answering questions in the question box.

THE PRESIDENT—While we are waiting for Mr. Odiorne we might consider the first question on the list, which is as follows:

"What experience has been had in the spontaneons combustion of coal; and what is the best preventive of the same?"

Is any one prepared to answer the question? Mr. Lansden ought to be able to answer that.

MR. LANSDEN—Well, I do not know why you have called on me. I have charge of works that have had quite a fearful accident of that kind, but it was before I took charge. I use a rod and take the temperature of the coal in that way. I have had it up to about 85° or 90°, and that is as high as I ever got it, but coal of that kind we put out of doors now-a-days.

MR. MILLER—I think the English Parliament appointed a commission to look into that subject. They had a great deal of trouble in the carrying trade to India, and this commission tried to find some connecting link between spontaneous combustion and the chemical composition of the various coals. I do not know whether they ever came to any results as far as that is concerned, but they recommended that cartridges made of short pieces of pipe and filled with compressed carbonic acid, and fusible plug, be distributed throughout the coal pile. In case of an elevation of temperature this plug would fuse and the carbonic acid would smother any fire that had started. Whether that has ever been tried or not I do not know.

MR. SOMERVILLE—The best preventive for spontaneous combustion is this, let the air circulate through the coal. It is only by the non-circulation of air that spontaneous combustion is possible, and the best way to accomplish this is to have posts or columns through the coal so as to break it up into smaller heaps. By the use of these columns which are hollow, you will see that it subdivides the mass and allows a certain amount of air to percolate through. Mr. Lansden's plan—to periodically take the temperature—is also good; but I believe where the plan of putting posts through the coal has been adopted there has been no spontaneous combustion.

MR. HARPER—It may be interesting to the gentleman who asks this question to know that one of the best experts in England published a article on this same question, which appeared in the *Journal of Gas Lighting* within the last month or so—I am not able to give the exact date.

THE PRESIDENT—As we have been unable to find Mr. Odiorne, and as we have about three-quarters of an hour before the afternoon session will close, it is thought best to call up the paper following Mr. Odiorne's, which is,

FUEL GAS AS VIEWED THROUGH A COAL GAS MAN'S SPECTACLES,

by Mr. K. M. Mitchell, of St. Joseph, Missouri. Mr. Mitchell, I am sorry to say, is not present, but Mr. Jenkins has volunteered to read the paper.

MR. JENKINS read as follows:

With the advent of natural gas, bringing with it as it did so many beneficent results in industrial pursuits and domestic life, naturally the mind of the entire gas fraternity was turned upon the problem of providing fuel gas; that is, fuel gas that would take the place of coal, not only in localities where natural gas could not be found, but also in localities where natural gas was found, in anticipation of its giving out at an early day. This problem has not been solved, though we all cherish the hope that some day it may.

In looking over the various processes for making fuel gas we see several methods of accomplishing the same end. It is pretty generally conceded amongst fuel gas men that a process which will allow of bituminous coal being charged into the top of a retort or generator, and pass down by gravity until the several processes of distillation are completed, leaving nothing but the clinker and ash to be removed at the grate below, is the most desirable.

The value of the resultant gases for quantity and quality depends upon the quality of the coal introduced into the generator, as the heating agents are hydrogen, carbonic oxide, marsh gas, and a small per cent. of olefiant gas.

To produce a gas that is richest in heats units you must have a coal that produces a large quantity of good coke. In order to decompose the steam, incandescent carbon is necessary. The composition of gases from bituminous coals is given as follows: Hydrogen, 54.5; carbonic oxide, 36.4; carbonic acid, 1.6; marsh gas, 7.5. It is also absolutely necessary in vending a fuel gas, particularly a gas which contains over one-third of its volume of deadly poison, and which is to be used for domestic purposes, that it have a distinct and positive odor, an odor that will be lasting when mixed with air.

It will be seen by the above analysis that the only odor to the gas is from the small per cent. of marsh gas. In our regular illuminating gas we get the well known carbonaceous odor from over 42 per cent. of its volume. The slightest leak upon a fixture or burner accidentally turned on, or burner in gas stove, which may be extinguished from boiling over of the contents of a kettle, is quickly detected and remedied. Not so with fuel water gas. If a burner is accidentally turned on and not lighted the presence of the deadly fluid is not detected by the victim.

Symptoms of poisoning from carbonic oxide are as follows: Burning feeling in the skin of the face, followed by giddiness and headache. Headache grows more intense, and chief point is in temples. There is strong pulsation in the temporal arteries. There is also nausea with peculiar noises in the ears, and, as the poisoning advances, there is loss of consciousness. There may be, also, according to Boehm, in "Ziemssen Encyclopedia," loss of mind, or a pleasant, ecstatic feeling, a sense of fatigue both mentally and physically, eccentric pains in the limbs, and certain peculiar disorders of the skin.

In order to remedy this great objection to fuel water gas, fuel gas makers have introduced into the gas while being generated a few gallons of oil to each 1,000 feet manufactured.

Another plan is to allow the purified water gas to pass over crude Lima oil which is periodically injected upon the water in the gas-holder tank. The latter plan gives to the gas a perceptible odor at the point of escape, but the odor is not enduring and clears away or separates from the gas quickly.

In previous discussions on fuel water gas the relative values of coal gas and water gas by volume have been stated to be 666 and 292 respectively. In the *American Gas Light Journal* for March 21st, 1892, Dr. E. G. Love is quoted as saying that the common coal gas of London, with an illuminating power of 16 to 17 candles, has a calorific power of about 668 units per foot, and that the product obtained by decomposing steam by incandescent carbon, as effected in the Motay process, consists of about 40 per cent. of carbonic oxide and a little over 50 per cent. of hydrogen. This mixture, he says, will have a heating value of 300 units per foot. This is, in my judgment and experience, about the correct value

Although it has been stated by the advocates of fuel water gas that the air dilution, necessary for the complete combustion of illuminating gas, detracts from its theoretical value 50 per cent., it is also said in favor of water fuel gas that the heat is intense and concentrated. This is also true of the arc electric light; the heat is intense and local. Yet, we want gas for the purpose of boiling water, heating our ovens, etc. The gas that will give us a uniform heat in our ovens, a general heat around our boiling vessels, is the one to be most desired.

The question to the consumer is not what is the theoretical value of the gas or air dilution to complete combustion of the gases, but how much monetary value can be got out of them, *i.e.*, how many feet of gas will I consume a month doing my cooking or heating by gas when consumed in the best means at hand.

We have before us two cooking stoves for example. They are both of the best and latest patterns, made especially for the work for which they are intended. They have four holes or burners on the top and two burners for the broiling and baking ovens. One is a stove fitted to burn coal gas, 16-candle power; the other is fitted to burn fuel gas with no illuminating power and of the composition as given in the before mentioned table. We must gauge the stoves so that when in use the work can be done as expeditiously with one kind of gas as with the other. With the coal gas cooking stove we heat the oven in 15½ minutes from a temperature of 76°, ready for baking, consuming 6½ feet of gas. We place in the oven a six-pound pan of bread, regulating the gas to properly bake the bread. When baking is done we note the time from the lighting of the burners to the completion of the operation. Total number of feet of gas burned, 17.5; pressure of gas, 14.10; total time, 1 hr., 33 min.

With a fuel water gas stove of the same dimensions we heat the oven in 17 minutes from a temperature of 76°, ready for baking, consuming 20 feet of gas. We place in the oven a six and one-half pound pan of bread, regulating the gas to properly bake the bread. When cooking is done we note the time from the lighting of the burners to the completion of the operation. Total number of feet of gas consumed, 64; pressure of gas, 32.10; time, 1 hr., 28 min.

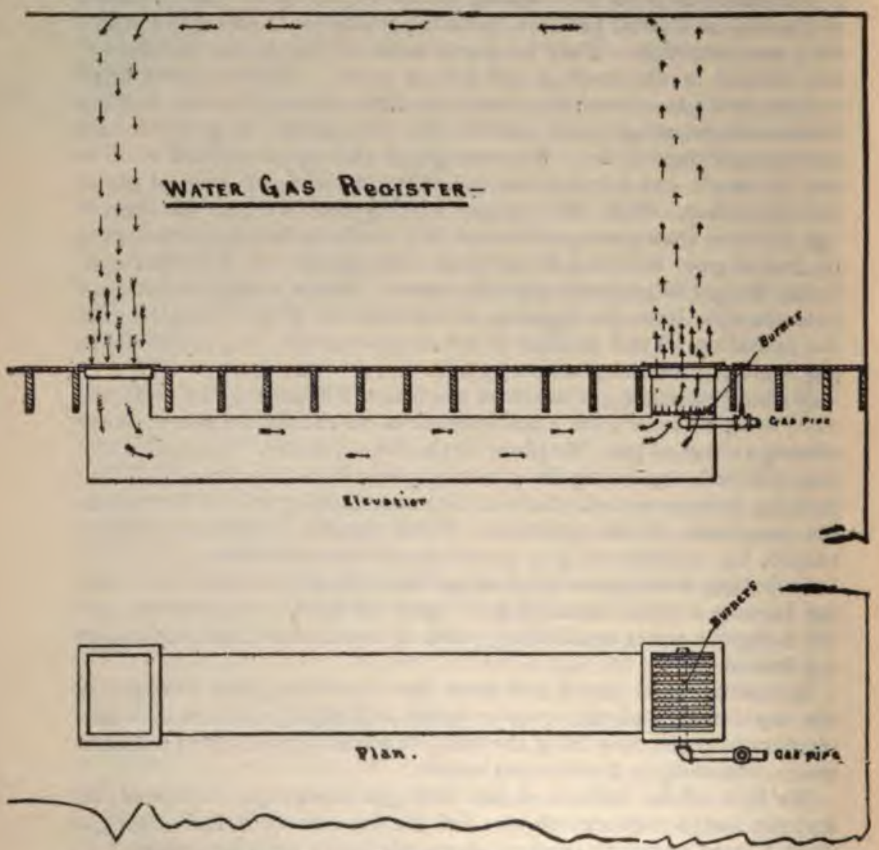
In boiling water upon the coal gas stove we place over one of the top burners a vessel containing 2 quarts of water, temperature, 48°. We bring the water to a boiling point in 10 minutes' time, consuming 2.8 feet of gas.

In boiling water over a fuel water gas stove we place over one of the top burners of the stove a vessel containing 2 quarts of water, temperature, 48°. We bring the water to a boiling point in 11 minutes' time, consuming 5.5 cubic feet of gas.

We light all the burners of the coal gas stove; gas consumed, 60 feet per hour; pressure, 16.10. All the burners of a fuel water gas stove lighted consume 160 feet of gas per hour; pressure, 32.10.

I have in my mind a room heated by fuel water gas. The arrangement of the heating apparatus is unique, and I herewith present a rough sketch of the furnace or gas register.

You will see by the sketch the whole of the products of combustion pass into the room. The second register at the back of the store room is connected to the front register, or, in other words, the registers 1 and 2, at the front and back of store, are connected together by means of a galvanized iron duct below the floor. The gas jets or burners are fitted in the vertical portion of air duct in No. 1 register. The heated air and gases rise in the room. The heating of the air in No. 1 register causes a draft in No. 2 register and draws the air along the duct to No. 1 register to be heated. The air in the room is kept in constant circulation. The size of the room is 20 x 50 x 10. From December 7th to March 29th (leaving out 17 Sundays), we have 96 days of heating. The average temperature for the month of November was 34.2°; December, 33°; January, 16.5°; February, 33°, and March, 33°. The amount of gas consumed in the 96 days was 90,800 cubic feet. The store was open 10 hours per day. The temperature of the room was about 65 to 70° during the coldest of weather. The apparatus seemed to give satisfaction as far as heat is concerned. Nothing is said about the condition of the atmosphere with this volume of car-



bonic acid produced and pouring into the room. What the occupants of the room suffered during this time I am not prepared to say.

In another instance we have a young ladies' institute, heated by water gas, using gas heating stoves as made by the Chicago Gas Stove Company. They are sheet iron stoves, open in the front, with horizontal burner. In each horizontal pipe there are inserted lava tips, the flames from which are directed against an inclined plate holding tufts of asbestos. The stoves are connected to a flue and the products of combustion in this instance pass up the chimney.

	No. of Stoves.	Size.	Hours Burned a Day.	Ft. Per Hour.
Sitting room	1	10	16	62
Parlor	1	10	3	62
Reception room	1	10	14	62
School room	1	12	14	75
School room	1	10	6	62
Repository	1	12	6	75
Bed room	1	12	3	75
Bed room	1	5	2	31
Bed room	1	5	2	31
Bed room	1	5	..	31
Bed room	1	5	4	31
Bed room	1	5	9	31
Bed room	1	5	4	31
Elocution	1	5	1	31
Music	1	5	14	31
Music	1	5	14	31

Amount of Gas Consumed.

October	46,500 cu. ft. at 50 cts. per M	$ 23.25
November	121,900 cu. ft. at 50 cts. per M	60.95
December	147,000 cu. ft. at 50 cts. per M	73.50
January	188,000 cu. ft. at 50 cts. per M	94.00
February	154,300 cu. ft. at 50 cts. per M	77.15
March	157,600 cu. ft. at 50 cts. per M	78.80
April	121,900 cu. ft. at 50 cts. per M	60.95
		$468.60

In addition to this, there was used in gas range for cooking purposes, 169,200 cubic feet of gas for the nine months. We will assume that 40,000 cubic feet will be consumed in the remaining three months, making 209,200 cubic feet, cost $104.60. There was used during the cold months, 19 cords of wood at $4.50 per cord, making $85.50. Total money paid for heating and cooking for the year, $658.70. Cost of fuel for the same time—the year previous—50 cords of wood at $4.50; 20 tons of coal at $8.25 per ton; total, $390.00.

In summing the matter up the writer cannot see where there is anything done by fuel water gas that cannot be done by the illuminating gas now at hand.

In cooking or heating stoves one foot of illuminating gas will do more general work than two feet of the fuel water gas. It takes less capacity of mains, meter, etc. For example, to convey a certain amount of fuel water gas a 10-inch main is required. To convey the same equivalent in heat units of illuminating gas a main of 7-inch diameter will do the work.

To measure the gas for a fuel water gas cooking stove a 10-light meter is required. To measure the illuminating gas for cooking stove same size a 5-light meter is sufficient. Throughout the whole operation it is necessary to double the capacity of the works and distributing plant in vending fuel water gas as against a good illuminating gas plant.

In my judgment the secret of gas for fuel purposes lies in the cheapening of the price of illuminating gas used for this purpose, making the price of this article 80c., $1 or $1.25, according as you are more favorably located.

A gas plant is now in operation in St. Joseph which relies almost entirely for financial success upon the question whether its use as a fuel will displace solid fuel throughout the community. This gas is sold for 50 cents per 1,000, and does not carry over 300 heat units. The determination of the question will only be had after the artificial stimulants which are now offered the public to induce its adoption have ceased, and opinion is allowed to pass strictly upon the merits of the gas.

DISCUSSION.

THE PRESIDENT—Gentlemen, this paper is before you for discussion, and we will be glad to hear from anybody who desires to speak about it.

MR. EVANS—I have listened to the reading of this paper with more than ordinary interest; and I, too, am very sorry that the author is not here. Nevertheless, I cannot let go by unchallenged some of his statements. First, I wish to call attention to the analysis of the fuel gas, as given by Mr. Mitchell, which shows 54.5 per cent. hydrogen, 36.4 of carbonic oxide, 1.6 of carbonic acid, and 7.5 per cent. of marsh gas. You will notice that all through this paper he has stated that this fuel gas has about 300 heat units. If any of you care to figure up the heat units that this analysis gives you will see that it figures 368 heat units. You will also notice that Mr. Mitchell calls attention to a comparative test of the two gases in bringing water from 48° to 212°. I believe he states that he brings two quarts of water from a temperature of 48° to 212°—raising it 164°, using 5½ cubic feet of fuel gas and doing the work in eleven minutes. If you will figure up the number of heat units utilized in bringing this water to 212° you will see that he has simply utilized 33.7 per cent., or a loss of 66.3 per cent. Is there any gas engineer present who would be willing to say those are the best results he could get from heating water? Then, again, I wish to call attention to a test that he has made in baking bread. He says he has used a gas stove—presumably of the best make—to bake bread, using fuel gas and using illuminating gas. He asserts that it takes 17 minutes to heat the oven first, using 20 cubic feet of gas, and that it required 1 hour and 28 minutes to bake the 6½ pounds of bread, using a total of 64 cubic feet. If he had removed the spectacles of prejudice things might have been different. Since receiving this paper I made a test of baking bread in a No. 2 Van Wie stove, using fuel gas. I found I was able to bake 6 pounds and 9 ounces of bread in less time and with less gas, and that in heating the oven it required but 5 minutes and consumed but 5 cubic feet. The bread was baked with 20½ cubic feet and the time was 34 minutes, the total quantity consumed in baking the bread and heating the oven being 25½ feet, and the total time consumed was 39 minutes. Observe the difference; Mr. Mitchell consumed 2½ times as much gas and took up 49 minutes more time baking even less bread. Then, again, still further along in the paper he states that a room 20 feet by 50 feet by 10 feet was heated with gas for 96 days, 10 hours per day, and that there was consumed 90,800 cubic feet of fuel gas. The average temperature outside was 29.9°, and the room was heated to an average temperature of 68°. The average amount of gas burned per hour was 94.6 feet. He refers here to the amount of products of combustion and the possibly serious effects that might occur to life while allowing these products to escape into the room; although he did not hear of any deaths he thought there might some occur which escaped his notice. Let us see what the products of combustion would be that escaped into the room burning 94.6 cubic feet of fuel gas per hour. I find that 500 cubic feet of carbonic acid and nitrogen were escaping into the room each hour; 5 pounds of carbonic acid and 34 pounds of nitrogen—a total of 39 pounds of impurities. Gentlemen, I think any of you will admit that if that room was being illuminated by illuminating gas that you could not do with less than 16 burners. If such were the case, then they were burning 5.9 cubic feet each, and would consume 94.6 feet per hour. Let us see what the amount of products of combustion would be in that room, and how people must suffer who use illuminating gas for illumination. The amount of products would be 950 feet per hour of carbonic acid and nitrogen. That would be 7 pounds of carbonic acid, and 66.22 pounds of nitrogen, the difference in favor of fuel gas being 190 per cent. And they continue using it for illumination; we do not hear of any deaths; we do not hear of any objections. Still further along in the paper Mr.

Mitchell calls attention to the fact that fuel gas is as 292 is to 666. Then, if such is the case, the above illuminating gas should heat that room up to 117.5°. Why don't it do it? Because those are theoretical values. It should heat 130 per cent. more than the fuel gas; why don't it do it? Further, in his paper he says that the fuel gas plant depends entirely for its financial success upon the question of whether its employment as a fuel will displace solid fuel throughout the community. I see no mention of the fact of their using that fuel gas for illumination. He does not say in his paper that fuel gas is used for illuminating purposes in the city of St. Joseph in $\frac{9}{10}$ of all the business places throughout the city; he does not say that the fuel gas company sold over half a million feet of gas per day in December; he does not say that the fuel gas company has removed 700 of his meters; he simply asserts that it depends entirely upon its fuel. Gentlemen, I am in the fuel gas business, and I am only sorry that Mr. Mitchell is not here; for I would certainly like to have him reply to some of these statements. "Consistency, thou art, indeed, a virtue!" Is this consistency?

The President—We would like to hear some further remarks upon this subject. There must be many that are prepared to say something.

Mr. Lansden—I would like to have Mr. Young give us his experience. I think he has had the most varied, intelligent experience in regard to heating with fuel gas. The illustration that I want to bring out is this: You take a city of, say, 300,000 inhabitants, and, from Mr. Young's experience, as I recollect, he found that the average consumption of fuel gas was about 3,000 feet a day to the consumer by meter. Now, in a city of 20,000 consumers, burning their furnaces and their fires, depending entirely upon its fuel gas for heating, this would represent a consumption of 60,000,000 per day. How many times through the winter, in almost every climate except the extreme north, do we want to stop our furnaces. Now, imagine a city being supplied with fuel gas, say 20,000 consumers burning 3,000 feet of gas a day, who shut their gas off to-day, and to-morrow they want to use it. How will the question ever be settled unless by 50 to 60 million storage capacity, or an immense number of men kept idle to watch the varying conditions of the weather. The fluctuation we have with illuminating gas is very wonderful. One of the greatest questions in London to-day is the fogs. They tell me there they have some days a fluctuation of 35 per cent. in the gas consumption. What a wonderful expense that is to them. The question with them to-day is an apparatus by which they can make up for this fluctuation, merely in light; but, imagine the fluctuation we would have for heating, in comparison.

Mr. J. Young—I have had considerable experience with fuel gas—not with the manufactured, but with the natural article. We began, first, by supplying the gas by contract—it was so plentiful; and we supplied our consumers at such low prices that they simply retained their old coal appliances and burned the gas in those with the result, I suppose, that something like 75 per cent. of the heat went up the chimney. Within the last two years we have been supplying almost exclusively by meter. The first charge by meter was 8 cents per 1,000 cubic feet. It was afterwards raised to 10 cents, then to 15 cents, and now we are selling at 20 cents. We have found that the result of the rise in price has been to induce people to put in more economical appliances, if they want to use natural gas for fuel purposes. During this last winter, when we raised the price from 15 to 20 cents, we found a great majority of our consumers fitted up their houses partly or wholly with some kind of economical appliances. The result has been that, while a number of people have partially discontinued the use of natural gas, we have lost very few consumers altogether. They still use it in some parts of the house, in bedrooms and for cooking purposes; but a good many have shut off their furnaces where they did not have those of the proper kind, as they found it too expensive. Of course, in large houses, to people who do not care for the few extra dollars cost in their housekeeping, it makes very little difference. I notice in the paper of Mr. Mitchell that a large building there in St. Joseph has been heated with manufactured fuel gas in St. Joe for a cost of $660, I think the sum is, or about double the price it would cost for heating the same house with wood; and the total consumption of gas was something over a million feet for that whole house. If it had been natural gas at 20 cents per 1,000 that was used in those appliances, you can see that that house would have been heated for a small amount of money. If appliances of that kind were in every house we could still raise the price of gas a great deal; but we have this difficulty to contend with in natural gas—people do not believe it will be permanent; and the owner says, "I am not going to the expense of $100 or $200 to put in a lot of appliances in my house, because you cannot tell me whether you will have natural gas next year or not; if I were assured that we would have natural gas always, then I would go to that expense." The tenant of a house says, "I am not going to the expense of putting economical appliances in another man's house." All these objections come up about putting in economical appliances for the use of natural gas. I do not know of any process by which manufactured fuel gas could be made to compete with coal in Pittsburgh; even at 10 cents I am sure it would run a good deal higher than coal. Of course, as I have said, I have had no experience in manufactured fuel gas; but the natural gas companies are extremely anxious to find some substitute to take the place of natural gas when it is exhausted, and I think a great deal can yet be done in the way of utilizing all the heat that fuel gas can produce, and thus assist in making the manufactured article a possible success. I do not know that I have anything further to say on the subject.

MR. SOMERVILLE—I have a few notes here which I expect you (addressing Mr. Cowdery) can say more about than I can, for they were taken from your report on Hyde Park, Chicago, fuel gas.

Sample No. 1.

CO	33.3
H	49.1
CH_4	3.7
CO_2	5.8
O	0.0
N	8.1
	100.0

The heat units contained in the gas are 322 per cubic foot, which goes to show, I think, that Mr. Mitchell comes very near the truth. Sample No. 2, same kind of gas, gave, heat units, 320; sample No. 3, heat units, 318; and the average efficiency was 48 per cent. Now, sir, if I remember rightly, when you made these experiments you took some precautions to get the full benefit of the gas that was heating the water. As I understand, from Mr. Mitchell's experiments, he did nothing of the kind, but used a common stove, and treated the water as in everyday use. So that I have no doubt this will account for the difference in the efficiency of the two experiments. A slight draught or movement of the air would make the difference. As to the other test, of baking bread, it seems to me to be a question of whether he would want it done or undone. Mr. Mitchell wants his a little brown; this other gentleman does not. This is all the difference. There can be no question at all that there are just one-half the heat units in this fuel gas that there are in 20-candle coal gas. This thing, of the efficiency of the gas, is where the fuel gas men make a great mistake. They say that, in a ton of coal containing 27,000,000 heat units, only from 10 to 13 per cent. of the heat is utilized, whereas, in using gas for heating, all the heat is utilized. There cannot be a greater delusion than this; and this is just where the trouble comes in. I have experimented with natural gas under our boilers, and have almost come to the conclusion that there is as much heat wasted in using gas as there is in using coal. Remember that the flue has to be heated, and that means a great waste of gas and heat. If, as Mr. Young has intimated, we can ever get appliances to utilize all the heat units in the grate, then there would be some prospect of using this gas, but it never can be done. The flue must take off the heated products, and this means always a tremendous loss of efficiency in any kind of fuel that is used. This sketch of Mr. Mitchell's showing the products of combustion entering into the room, will never work; people could not stand it,

MR. HIGHLANDS—I also have had some experience with fuel gas, and to say that I am a disappointed man to-day does not half express it; indeed, I feel very much abused. Up to four years ago I lived on Fremont Street, in Allegheny, and bought my natural gas from Mr. Young. The price was very low, being a lump sum per year, and I was very well satisfied with it; but I knew that he felt then, as he does now, that the time might come when he would be compelled to raise the price of gas, so I moved out to the East End of Pittsburgh. They charged me 10 cents per 1,000 for natural gas, and as I was burning from 75,000 to 130,000 feet a month, I could not stand it. I heard of the west, where fuel gas was plenty and cheap, and I moved out here for the purpose of getting it; and now I am told by the Messrs. Young that I cannot get it out here. It is not fair. While in Indiana I piped the towns of Muncie and Marion, and supplied them with natural gas. We had about 380 pounds pressure—it was in the fall of the year, and everybody had all the gas he wanted. All we had to do was to rake in the shekels, and we did it. We had a cold snap about the first of the year, and then we did not have any gas at all, apparently, while the day before we had lots of it. We found some friend in Washington, Pa., who wanted just such a plant as we had, and he got it. But I as yet was not satisfied with the matter. The Philadelphia Company, of Pittsburgh, was afraid that natural gas was going to give out, and they went across to the South Side and built a small experimental plant to make fuel gas, the operation of which I watched very closely. My friend Mr. Young knows something about that plant. They had about $100,000 worth of experience before they got through with it, and as yet do not have an artificial gas.

THE PRESIDENT—Mr. Humphreys, I think some of your companies have had experience with fuel gas.

MR. HUMPHREYS—I do not think I am in a good position to-day to say much about fuel gas. We have had considerable experience, and we have gained a great deal by it, in some directions. Some of the points raised by Mr. Mitchell are confirmed by our experience, but we do not consider our experiments and work are at an end; and I therefore prefer to withhold my last word. I think, in one or two points, the criticism of Mr. Mitchell's paper would be hardly fair. For instance, the comparison is made between the burning of so many burners up in the ceiling, giving light, and the burning of the same amount of gas in a special furnace, let in the floor of room as shown in Mr. Mitchell's paper, with the result that the air of the room is pumped over and over again to supply oxygen to the furnace. I do not think that is a fair comparison at all with the burning or illuminating gas up in the ceiling, where the products of combustion are delivered above the heads of the occupants of the room, and where it is presumed we will have some chance to carry them off. I know of my own experience in one or two cases where I have sat in rooms equipped with these furnaces, and with every desire to find them a success, and without having any predisposition to headache, that I was able to stand it only about half an hour. I think another unfair way to look at it is to assume that Mr. Mitchell claims that death results from the use of these furnaces. I do not think that is fair. I presume he was referring simply to the injury to the health of those constantly living in a house heated in that way. We all know it would not be conducive to health to use carbonic acid and the products of combustion generally in the place of oxygen for filling the lungs.

THE PRESIDENT—I think some of the remarks made by Mr. Evans are misleading. He is repeating some of the experiments of Mr. Mitchell, doing the work as quickly as it could be done, and using as much gas as is necessary to do it in that short space of time. We all know that to get the greatest efficiency from any gas we must do the work we have to do quickly. There is no doubt he could bake his bread in 38 minutes, and bake it so that it would be done and have very good bread—and he could not bake it in much less time than that; but he has made his comparison with Mr. Mitchell's use of coal gas in a longer time. If Mr. Mitchell was allowed to repeat his experiments and use gas enough to do it in the same length of time that Mr. Evans did his, the proportion of gas used would remain about the same. This result has been tried again and again by everyone, and it remains a fact that the practical efficiencies obtained from the different gases are about in proportion to the number of heat units, as shown by analysis. That cannot be disputed. My own experiments with gaseous fuel for heating purposes amount to this. I thought the best way to use gas for heating purposes was by means of the hot water system of heating; and to determine exactly what could be done in practice, I found a house in Milwaukee which seemed to have as good a system of hot water heating as any that I ever came across—it was a brick house, two stories, and contained about 26,000 cubic feet of space to heat and was kept warm all through the season. The owner stated that he used from 9 to 12 tons of hard coal a year, and that was all, which would show that he had a good system. I had built a heater in which gas could be used for heating the water to the very best advantage. I rebuilt that heater two or three times, at a total cost of about $150, to put it into that house so as to get the best results from the use of gas. We used illuminating gas, or the same that we were furnishing for illuminating purposes, and that was used so that the products of combustion went to the chimney at from 100° to 120°. We used that all through the month of April, a year ago. The total temperature averaged a little less than 30° throughout the month. The average consumption of gas for the 24 hours was 1,700 feet. It proved conclusively to me that our illuminating gas was worth 30 cents compared with hard coal at $6 a ton for that purpose and used in that way. This was out of the question, of course; it was too expensive. We repeated the experiment in another house in January this last year; a single room in the northwest corner of the second story of the house, was used on account of our prevailing cold winds coming from a northwesterly direction. We used a "Reflector Heater," and had the heater in the room, which was the only means there was of heating. We found the cost by that system was $2.25 per 1,000 cubic feet of space heated; whereas, in the first experiment, it cost $1.50 per 1,000 feet of space heated. We gave up the use of gas for heating purposes, believing that it could not be done at satisfactory prices.

MR. EVANS—Referring to the remarks of Mr. Somerville regarding the underdone bread, I am afraid he is not very familiar with the baking of bread, or he would be aware that it can be baked, and baked right, in that number of minutes. I will state for his benefit that the bread I baked was overdone; in fact it was quite brown. If he will make a few experiments in that direction he will learn something about cooking. Speaking of the products of combustion going into the room, referring to what Mr. Humphreys has just said, I do not claim that it is a proper thing to permit the products of combustion of any gas in any large extent to go into a room. The case referred to by Mr. Mitchell was a store. The opening of the door at frequent intervals supplies fresh air. Referring to the products of combustion from the burners not being a fair comparison, I think the burners in illuminating a store are pretty well distributed, and a current of air is continually created towards each burner by the burning gas. As to the variation of temperature between the ceiling and the floor, there might be some disadvantage in making the comparison I did; but does it vary 190 per cent? That is the point I want to make. Then, again, speaking of fuel gas, I do not say that fuel gas can be used at the price we sell it to the exclusion of other fuel. It never suggested itself to me—it is not true; but is it not a step in advance, and is not the very thing that all of you gentlemen are aiming at, to get the price of gas reduced to a point where consumers can use it for fuel purposes? We have a striking example right in Hyde Park, Chicago. We have a plant in operation there. It is easy to get there, and any of you gentlemen are at liberty to investigate what we are doing. We are selling gas at 50 cents a 1,000, and the result is identically the same as it is in Grand Rapids, as it is in Milwaukee. You put down the price of your gas and you double your consumption. Why is it? Because you are selling it at Milwaukee for 80 cents, and when we sell it for 50 cents the people realize that the gas is cheap and will use more of it. Now, I do not see why you gentlemen object to fuel gas, even if it is a non-luminous gas. We use it with appliances that are best adapted to using it right. As I was going to remark, to give you an idea of the increase of our business in Chicago, last month we set 273 meters, and we have so far this month set 163 meters; we are 215 orders behind on gas ranges. We have out in Hyde Park about 1,700 gas ranges. Is it growing on its merits, or what is the reason that people apply for it so fast that we are actually unable to fill the orders? Is there not a reason for it?

MR. HUMPHREYS—I would like to ask Mr. Evans, only if it is a fair question, of course, what was the average price netted for the fuel gas sold at Hyde Park?

MR. EVANS—The average price netted was a trifle over 50 cents, because our gross price is 70 cents, and we make a discount of 20 cents per 1,000, when it is paid before the 12th of the month.

MR. SOMERVILLE—I trust that Mr. Evans will not go away from here with the idea that any of us is opposed to fuel gas. Nothing could be further from the truth. We are all in favor of fuel gas, or gas for fuel; but the question is, how to make it in the best and cheapest way.

MR. EGNER—I have had a little experience with fuel gas. I spoke of it a year ago to this Association. I was requested by the President of my Company, who is also a member of this Association, to convert one of our water gas works into a fuel gas plant, just to make non-carbureted water gas. We did that, and advertised fuel gas, I believe, at 50 cents per 1,000. After advertising we obtained, I think, only some 16 or 17 applicants, and consequently did not operate the works at all. Some time after that we were ordered to change a water gas apparatus that we had at one of the stations and to make fuel gas with it. I left St. Louis shortly after the beginning of the trial, but I believe they are not selling any fuel gas now. The Company had some 30 miles of mains, which they had acquired through the purchase of the plant of an opposition Company which went out of business, and which had not yet been put to other use. The Company was going to give it a fair test, and I believe it did; but I am informed they are not using any fuel gas now. The Company offered to sell the gas finally at 30 cents per 1,000, but the trial with fuel gas was not a success. I have been through the country a good deal lately, and I have seen that fuel gas for other than domestic purposes is successful wherever tried. I visited a works near Philadelphia, at Tacony. Thy used gas there for melting, annealing and tempering steel, and in forges; and I can say, from my own observation and information given me at the works, that they would use three times as much coal, if fired direct, to do the same work that they now do with the same coal turned into gas. I have been elsewhere, and have seen a like state of things, so that, for industrial purposes, it seems to be a very desirable thing; but for domestic purposes, my experience would point out that fuel gas has not yet reached that state of perfection which would lead us to make use of it with success as against our illuminating gas, employed in properly constructed gas stoves. The latter is decidedly to be preferred in point of economy, even by the consumer.

MR. EVANS—I do not think this is a parallel case at all. In the first place, Mr. Egner admits that he makes a partial producer gas. I would like to ask him two questions; first, how many days did he run that plant? and, next, did he have practical burners to burn that gas?

MR. EGNER—I should like Mr. Thompson to say how long they ran it; because, as I stated, I left St. Louis before they actually made gas for sale. The apparatus itself had been run for several years for making illuminating, but not fuel gas. I do not know how long it was run for making fuel gas only.

MR. THOMPSON—The apparatus was run upwards of three months. It was discontinued the 1st of October last. The burners we used were in some cases the special burners made for the use of fuel gas, and in some places the ordinary Bunsen burner, with the air ports stopped up.

MR. COVERDALE—I would like to say a few words on this question. I hope Mr. Evans will not go away from here even thinking for a moment that coal gas men are opposed to fuel gas, because they are not. I remember a great many years ago there was a fuel gas works erected at Utica, N. Y. The brother of a friend of mine who lived in Frankfort, Ind., was interested in the works, and he induced me to go to Utica to see that town lighted up with fuel gas. I did so, remaining there two or three days. They were kind enough to give me a couple of the burners which they used for fuel, but for lighting their streets they used the ordinary Fahnehjelm burner. Now, I know that our men at that time were opposed to fuel gas. One of our members wrote a paper at our convention on water gas—it was a very nice paper too, and I believe he was honest in it; but, we all laughed at him. I said then to the convention that it would be wise not to laugh at his paper, that we ought to investigate it, when if there was nothing to it that would be the end of it, but if there was we had better take advantage of it. Now what do we see to-day; there are water gas works in more than 100 places, and there is hardly a gas man to-day who will say anything against water gas. Those who do not have water gas would like to have it on dark days when they need a little more gas. The next thing to come up was electric lighting, and when they talked about lighting cities with incandescent lights I believe the majority of the gas men laughed at the idea—it could not be done, and yet it is bothering us all to-day. Now, we have got down to fuel gas. I happened to be in Jackson, Michigan, where they had a fuel gas plant. The town was lighted up with fuel gas used in Fahnehjelm burners. I tried to find something that would benefit me. I remained there two or three days, and saw probably 100 men who were burning that gas. I was in several houses where they used the gas for cooking and lighting. They also had electric lights. They were not burning them because they liked the fuel gas better; it was cheaper, for one thing, and it gave a better light. Now, I don't know anything about the cost of making fuel gas. Mr. Evans may have a place is Chicago, or St. Joe, or somewhere else, where he has the very best machinery. I know I have a friend in Hyde Park who I believe is a pretty smart old fellow. He took a great deal of interest in trying to post me, and his last letter to me said that the people liked the fuel gas, and they had 3,900 applications for meters that were not filled. These are facts. Now, how do we know what kind of a fuel gas is going to be the fuel gas of the future? I believe every man in this room ought to investigate that matter for himself, as to whether it can be made. I do not care about these gentlemen saying it has not been done; that has not anything to do with it at all. We said that water gas could not be made successfully; but it is. You said electric light would not be successful; and it is. It is not reasonable to say that fuel gas will not be successful, because I believe it will; and, therefore, instead of doing anything or saying anything for the purpose of preventing further experiments I believe every gas man ought to learn all he can to help try and bring it about if possible. If it is possible to make fuel gas in connection with our gas works, which will make more money for us, we want to do it. Let us investigate it.

On motion of Mr. Jenkins, a vote of thanks was tendered to Mr. Mitchell for his paper.

The Association then adjourned to Thursday, May 19, at 9:30 A.M.

SECOND DAY—MORNING SESSION.

The Association was called to order at 9:30 A.M., Thursday, May 19.

ROLL CALL.

The Secretary called the roll, the following members answering to their names:

Honorary Members.

Thomas, Jos. R., New York City.
Slater, A. B., Providence, R. I.
Harbison, Jno. P., Hartford, Conn.
White, Wm. H., New York City.
Humphreys, C. J. R., Lawrence, Mass.
Leach, Henry H., Taunton, Mass.
Barker, Forrest E, Boston, Mass.

Active Members.

Bauer, P., Boonville, Mo.
Baxter, I., Detroit. Mich.
Blodget, C. W., Brooklyn, N. Y.
Bolcom, H. C., Winona, Minn.
Brown, W. L., Evanston, Ills.
Butterworth, I., Columbus, O.
Byron, T., Birmingham, Ala.
Canby, R. H., Bellefontaine, O.
Chollar, B. E., St. Louis, Mo.
Clark, W., Philadelphia, Pa.
Coverdale, R. T., Cincinnati, O.
Cowdery, E. G., Milwaukee, Wis.
Croul, J., Detroit, Mich.
Darrah, S. M., Wheeling, W. Va.
Davis, D., Iowa City, Iowa
Dickey, R. R., Dayton, O.

Doan, F. M., Jacksonville, Ills.
Douglas, H. W., Ann Arbor, Mich.
Dunbar, J. W., New Albany, Ind.
Eaton, W. M., Jackson, Mich.
Egner, F., New York City.
Evans, C. H., Chicago, Ills.
Faben, C. R., Jr., Toledo, O.
Forbes, J., Chattanooga, Tenn.
Freese, F. W., Laporte, Ind.
Gwynn, J., Steubenville, O.
Harper, G. H., Kansas City, Mo.
Howard, J. B., Galena, Ills.
Hyde, H. H., East Saginaw, Mich.
Jenkins, E. H., Columbus, Ga.
Johnson, W. J., Fort Smith, Ark.
Knight, C. S., Fort Wayne, Ind.
Lansden, T. G., Washington, D. C.
Littleton, A. W., Quincy, Ill.
Lynn, J. T., Memphis, Tenn.
Merrill, H., Janesville, Wis.
Miller, A. S., Omaha, Neb.
Miller, C. R., Marquette, Mich.
Montgomery, J., Sedalia, Mo.
Morgans, W. H., Pontiac, Mich.
Murdock, J. W., Ottawa, Ills.
Odiorne, W. H., Springfield, Ills.
Penn, J., Washington C. H., O.
Perkins, B. W., South Bend, Ind.
Powell, C. S., Richmond, Ky.
Printz, E., Zanesville, O.
Ramsdell, G. G., Philadelphia, Pa.
Raynor, C. H., Adrian, Mich.
Rogers, J. F., Decatur, Ala.
Rowe, J. J., Cairo, Ills.
Sellers, W. B., Covington, Ky.
Shelton, F. H., Chicago, Ills.
Smedberg, J. R., Chicago, Ills.
Somerville, J., Indianapolis, Ind.
Stanberry, F. H., Pekin, Ills.
Starr, J. M., Richmond, Ind.
Steinwedell, W., Quincy, Ills.
Stratton, J. W., Valparaiso, Ind.
Tayler, G. H., Warren, O.
Thompson, G. T., St. Louis, Mo.
Tracy, W., Alton, Ills.
Walbridge, H. D., Grand Rapids, Mich.
Warmington, D. R., Cleveland, O.
Whipple, H. S., Rockford, Ills.
Wilkiemeyer, H , Evansville, Ind.
Williamson, J., Chicago, Ills.

Associate Members.

Adams, C. F. Buffalo, N. Y.
Bissell, W. G., Chicago, Ills.
Bredel, F., Milwaukee, Wis.
Buss, J., New York City.
Cressler, A. D., Fort Wayne, Ind.
Dell, J., St. Louis, Mo.
Dickey, C. H., Baltimore, Md.
Graeff, G. W., Philadelphia, Pa.
Gribbel, J., New York City.
Guldlin, O. N., Fort Wayne, Ind.
Harper, H. D., Chicago, Ills.
Harris, J. A., Philadelphia, Pa.
Hauk, C. D., Chicago, Ills.
Hayward, S. F., New York City.
Helme, W. E., Philadelphia, Pa.
Higgins, C. M., New York City.
Hubbard, H. M., Chicago, Ills.
Logan, Wm. J., Brooklyn, N. Y.
McDonald, Wm., Albany, N. Y.
McIlhenny, J., Philadelphia, Pa.
Morrell, E. E., Chicago, Ills.
Moses, F. D., Chicago, Ills.
Newman, C. V., Chicago, Ills.
Osius, G., Detroit, Mich.
Persons, F. R., New York City.
Prentice, A. T.. Chicago, Ills.
Randle, C. H., Chicago, Ills.
Ranshaw, H., Cincinnati, O.
Reed, C. A., Chicago, Ills.
Roots, D. T., Connersville, Ind.
Roper, G. D., Rockford, Ills.
Russell, D. R., St. Louis, Mo.
Smallwood, J. B., Baltimore, Md
Stout, J., Chicago, Ills.
Stratton, S. S., Chicago, Ills.
Van Wie, P. G., Chicago, Ills.
Weber, O. B., New York City.

ELECTION OF NEW MEMBERS.

THE PRESIDENT—The next thing in order is the report of the Committee on Applications for Membership.

The Committee submitted the following report:

To the Western Gas Association—Gentlemen: Your Committee have received applications for membership from the following named gentlemen, all duly indorsed by two members of the Association, and accompanied by the requisite initiation fee. We find them all to be eligible for membership, and accordingly recommend their election.

Active.

Beal, Wm. R., New York, N. Y.
Bivings, F. L., Birmingham, Ala.
Branch, A. H., Denver, Col.
Byrne, F. P., Detroit, Mich.
Calhoun, Robert, Bay City, Mich.
Christie, W. H., Corning, N. Y.
Copley, I. C., Aurora, Ills.
Corscot, John, Madison, Wis.
Elwood, Jas. G., Joliet, Ills.
Faux, J. A., Pittsburgh, Pa.
Highlands, S. M., Clinton, Ia.
Humphreys, Alex. C., Phila., Pa.
Lukins, W. H., Streator, Ills.
McKay, Wm, E., Boston, Mass.
Rodgers, John, Racine, Wis.
Stedman, Wm. A., St. Louis, Mo.
Stiles, A. K., Chicago, Ills.
Walker, Jos., Port Huron, Mich.
Williams, Wm., Sarnia, Ontario.
Woods, Geo. E., New York, N.Y.
Young, John, Allegheny, Pa.
Young, Peter, Knoxville, Tenn.
Young, Robert, Allegheny, Pa.
Young, Robert, Jr., Detroit, Mich.

Associate.

Felt, Henry, Jr., Cincinnati, O.
Kendall, J. R., Terre Haute, Ind.
Milsted, Wm. N., New York, N.Y.
Morava, W., Chicago, Ills.
Taber, Robert B., Boston, Mass.
Waugh, F. K., Chicago, Ills.
Whiting, J. H., Detroit, Mich.
Wickham, Leigh, St. Louis, Mo.

The membership of Wm. McDonald was changed from the "Associate" to the "Active" class.

On motion of Mr. Jenkins the Secretary was instructed to cast the ballot of the Association for the names contained in the report. The Secretary cast the ballot and so reported, whereupon the new members were introduced to the Association.

REPORT OF THE BOARD OF DIRECTORS.

The report of the Board of Directors was read:

DETROIT, MICH., May 17, 1892.

A regular annual meeting of the Board of Directors of the Western Gas Association was held this morning at 10 o'clock, at which were present the following members: E. G. Cowdery, B. E. Chollar, E. H. Jenkins, I. C. Baxter, A. S. Miller, W. H. Odiorne, A. W. Littleton.

On motion of Mr. Jenkins, the reading of the minutes of the last meeting was dispensed with.

The Board formally examined the following papers, which had been prepared for presentation at the forthcoming meeting, and unanimously approved the same, recommending that they be submitted to the Association for reading and discussion:

1. Petroleum Products—Hydrocarbons Employed in Gas Manufacture, by C. M. Higgins.
2. Some New Features in the Routine Office Work of Small Gas Companies, by W. L. Brown.
3. Everyday Gas Analysis, by W. A. Stedman, Jr.
4. The Construction and Operation of Half-Depth Regenerative Furnaces for Firing with Cheap Coal, by W. H. Odiorne.
5. Fuel Gas as Viewed Through a Coal Gas Man's Spectacles, by K. M. Mitchell.
6. Practical Photometry Simplified for Daily Use, by B. E. Chollar.
7. The Advantages of Recuperative Furnaces in the Utilization of Heat, by F. Bredel.
8. Origin of Coal and Petroleum, by A. E. Forstall.

On motion of Mr. Chollar, it was carried that a committee of five be appointed by the President, whose duty it shall be to revise the By-Laws of this Association, and report the results of their labors on the occasion of its next annual meeting.

On motion of Mr. Baxter, it was duly carried that the hours for conducting the business sessions of the Association during the Detroit meeting be from 9:30 to 12 o'clock in the morning; and from 1:30 to 5 in the afternoon.

The Secretary stated that he had recently purchased fifty Western Gas Association badges from the manufacturer, at an expense of $3.50 each, the actual cost of the same being 25 cents in excess of the former price; whereupon it was moved, seconded and carried that the price of $3.50 each be fixed for membership badges, instead of $3.25 as heretofore.

In accordance with the requirements of Section 2, Article VII., of the By-Laws, the Board appointed the following Finance Committee, from its own members, to examine the report of the Secretary and Treasurer, audit his accounts and report thereon to the Association: Messrs. A. S. Miller, W. H. Odiorne and I. S. Post, who have submitted the following as the result of their investigations:

Receipts.

To Membership fees..............	$ 155 00	
" Annual dues..................	803 00	
" Sale of badges................	78 00	
" Balance, from May 1, 1891......	196 91	
		$1,232 91

Disbursements.

By Secretary's salary..............	$ 400 00	
" sundry bills, as per vouchers....	596 45	
" bal., cash on hand, May 1, 1892.	236 46	
		$1,232 91

No further business appearing, the Board here adjourned.

A. W. Littleton,
Secretary.

On motion of Mr. Ramsdell, the report was accepted and the Secretary was instructed to spread the same on the minutes.

REPORT OF COMMITTEE ON PLACE OF NEXT MEETING.

The President—The next business in order is the report of the Committee on Place of Meeting.

Mr. Chollar—Mr. President, the Committee to whom was referred the arduous duty of selecting Chicago for the next annual meeting is unanimously in favor of that place for our next meeting.

On motion of Mr. Starr, the report of the Committee was accepted.

REPORT OF COMMITTEE ON NOMINATIONS.

The President—Is the Committee on Nominations ready to report?

Mr. Lansden—Mr. President and Gentlemen, I beg leave to report the following nominations:

President—Byron E. Chollar, St. Louis, Mo.

First Vice-President—E. H. Jenkins, Columbus, Ga.

Second Vice-President—I. C. Baxter, Detroit, Mich.

Secretary and Treasurer—A. W. Littleton, Quincy, Ills.

Directors—F. M. Doan, J. M. Starr, W. L. Brown, D. Davis, R. R. Dickey, Jas. Montgomery, J. T. Lynn, J. W. Dunbar and H. D. Walbridge.

ELECTION OF OFFICERS.

On motion of Mr. Odiorne the report was accepted, and the Chairman of the Committee was instructed to cast the ballot of the Association for the election to office of the gentlemen named.

REPORT OF COMMITTEE ON PRESIDENT'S ADDRESS.

The President—The next business in order is the report of the Committee on President's Address.

Mr. Ramsdell, of the Committee, submitted the following report:

To the Western Gas Association—Gentlemen: Your Committee to whom was referred the President's Address beg leave to present the following report:

The address, as a whole, is of unusual interest to members of this Association, and we cordially advise a careful reading. Among its many valuable suggestions we call particular attention to the following:

1st. We cordially approve of all that is said concerning the importance of gas companies being represented at these meetings.

2d. In regard to the suggestion of holding two annual meetings, we deem this subject of too great importance to decide during the brief time at the disposal of this Committee, and recommend it be referred to a Committee of five, to consider and make report to our next meeting.

3d. We fully approve of that portion of the address referring to the subject of entertainment.

4th. While we doubt the wisdom of changing the time and place of annual meetings, unless conspicuously necessary, we would recommend that the Board of Directors be clothed with power to make such change, if by them deemed for the best interests of the Association.

5th. We most fully indorse that portion of the address relating to municipal control, and recommend a careful perusal of this portion of the address by the members.

6th. We particularly call the attention of the fraternity to the remarks made upon the subject of gas for fuel, and to the strong arguments presented in the remarkable success and practical results of this feature of the gas business as shown, and would emphasize the marked increase following low prices. We recommend a careful study of the "law of cause and effect," as contained in the figures given.

7th. We fully concur in the argument advanced regarding successful competition with electric light through the means of high candle power.

8th. Referring to that portion of the address touching the uniformity of special castings, as adopted by the Society of Gas Lighting of New York, we recommend the adoption of a resolution adopting the same standards; and also suggest a resolution of thanks to the Committee of the Society of Gas Lighting who have so faithfully executed the work. Respectfully submitted,

G. G. RAMSDELL,
JAS. SOMERVILLE,
WALTON CLARK.

THE PRESIDENT—What is your pleasure with this report, gentlemen?

MR. JENKINS—I move that it be received.

MR. LANSDEN—I would like to suggest, and I will put it in the form of an amendment to that report, that 500 copies be printed and the Secretary instructed to send a copy to each member of the Association.

THE PRESIDENT—I hardly think it necessary.

Mr. Ramsdell—That was talked over by the Committee, but at one of our meetings—I think two years ago, if I remember aright—this same subject came up and it was decided not to do that hereafter. The address is published in the *Gas Light Journal*, and, as it is read in that form, it seems to be a useless expense. It was for that reason that the Committee did not recommend it.

Mr. Smedberg—I would like to suggest that our personal records of the proceedings of the Association will be entirely incomplete unless so valuable a paper as that appears among them, and I think that the question of expense should not stand in the way for one moment. I know, to complete my own files, I would very much prefer personally to have that paper among them. Those are simply my own personal views of it.

Mr. Ramsdell—I do not want it to be understood that the Committee in any way undervalued the importance of this paper. As a matter of fact the Committee were unanimously of the opinion that it was one of the best presidential addresses we ever had; but a precedent had been formed, and for that reason we thought it best not to break the rule so adopted.

The President—If I am correctly informed the statement of the finances of the Association will hardly permit expenditures that are not absolutely necessary. I think myself that the precedent had better be followed.

Mr. Smedberg—May I ask one question? Will not that same objection hold good with every paper that has been read before our Association? To my mind, the paper is of importance; it is full of instruction, and it as valuable to any of us as gas men as any purely technical paper. I think we can better do without the printing of every other paper rather than omit the printing of this.

Mr. Jenkins—It is not intended to exclude the President's address from our list of papers. It would be impossible to get that in among this list for this year. It would be published with the entire proceedings in the *American Gas Light Journal*, and so filed away. I doubt if very many of the members will take this and file it away, but they will file away the *American Gas Light Journal*. While I should be very much pleased to see the address published and sent out and utilized by our Board of Directors, yet I think I agree with the Committee that it is more money than we can afford to spend at this time.

The President—The original motion is the acceptance of this report. Those in favor of its acceptance—

Mr. Lansden—I wish to ask right here whether or not my amendment does not come before the original motion.

The President—Mr. Lansden's motion, I think, was not seconded.

Mr. Lansden—It was seconded. I made it as an amendment to the report.

The President—Please state the amendment again.

Mr. Lansden—It was an amendment to the report, as I intended to offer it, that 500 copies of the President's address be printed and a copy sent to each member. It was for that very reason that I wanted to get it before the Directors of several companies, and in that way let them see it. I know that each superintendent would refer it to the Directors.

The President—I will put Mr. Lansden's motion as an amendment to the original motion, that 500 copies of this report be printed and distributed. Those in favor of the motion, and I hope they will not be many, will please stand up. (The amendment was carried, as was also the original motion.)

The President—The report of the Board of Directors recommends that a committee of five be appointed to consider a revision of the By-Laws, to report at the next annual meeting. How do you want that committee appointed?

On motion, the President appointed the following Committee to revise the By-Laws, in accordance with the recommendation of the Board of Directors: Messrs. A. W. Littleton, George G. Ramsdell, B. E. Chollar, E. H. Jenkins and James Somerville.

RESPONSES FROM OFFICERS-ELECT.

Mr. Howard—I think we would all like to hear from our newly-elected President, Mr. Chollar.

Mr. Chollar—Mr. President and Gentlemen of the Convention: I fully appreciate the honor that you have conferred upon me in electing me President of the Association. I have sympathy for the Association in their impending calamity. In anticipation of some such action as this I had requested the President to appoint me chairman of the Committee, but he did not see fit to do so, and appointed a kind of scrub Committee (laughter); but I accept the situation, and entreat every member of the Association to stand by me, and that every man shall be at Chicago to help me out of the scrape.

The President—If there are any of the other newly-elected officers who would like to make a speech we will be glad to hear from them. (Cries of "Jenkins.")

Mr. Jenkins—I will simply say to you that I thank the Association for the honor conferred.

Mr. Baxter—Mr. President and Gentlemen of the Association: I must thank you for this unexpected honor, and assure you that I will try and fili the position to the best of my ability.

Mr. Littleton—I will make my speech about as short as possible. I thank you for the honor conferred, and I will continue to do in the future as I have in the past—try and fill the position to the best of my ability.

The President announced that the next business would be the reading of the paper on

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THE CONSTRUCTION AND OPERATION OF HALF-DEPTH REGENERATIVE FURNACES FOR FIRING WITH CHEAP COAL,

by Mr. W. H. Odiorne, of Springfield, Ills. The author read as follows:

Mr. President and Gentlemen of the Western Gas Association: My experience with the construction and operation of semi-regenerative benches constructed for firing with cheap soft coal dates from the summer of 1889, when we contracted for and had constructed in our works, by the Parker-Russell Manufacturing Company, 3 benches, of 6 retorts each, known as the half-depth, semi-regenerative bench. They are built with large flues and fire boxes for the purpose of burning coal as a fuel. These benches consist of arches 12 feet high, 7 feet 8 inches wide, and 9 feet 4 inches deep, and are fitted with 6 retorts, each 15 by 26 inches, and 9 feet long. The furnace is constructed with primary and supplementary air flues, running from the front, back and then returning, with openings into the furnace from the return flue—thus allowing the air to become thoroughly heated before entering the furnace. The primary air flue enters below and the secondary above the fire, and they are fitted with dampers in front to adjust the amount of air to be admitted. The door in front is tight and held in place by a clamp and screw. Each bench is provided with an ashpan to hold water. The heat from the furnace, after passing up around the retorts, passes to the front into flues adjacent to and parallel with the air flues to the stack above the benches, each bench being provided with a separate stack. A pit is constructed in front of the benches, the floor of which is on a level with the ashpan, and is covered with an iron floor, with a trap door for entering it for clinkering, etc.

I commenced to fire two of these benches December 6, 1889, by putting in the furnace a charge of hot coke drawn from a neighboring retort, and then, from time to time, adding some coal. The result was not what one would wish, as the soot began to gather, obstructing the draft, and in a short time the whole inside of the bench was a mass of soot. On the third day, not gaining any headway with the heat, I concluded to use coke again. This I did, and on the fifth day from starting had a fairly good heat and the soot had entirely disappeared. After running a few days with coke, and adjusting the air flues, I got a good white heat. I then commenced to fire with coal again, with much better results, but not satisfactory. I experimented with the air flues, and kept the fires well clinkered, but could only keep a red heat. Then I introduced a jet of steam directly under the grate bars, and this I found a great help, keeping the cinders from melting together and clinging to the sides of the furnace, being much easier to remove. It improved the heats some, but they were not what I wished them to be; and, after experimenting for about 5 weeks, I opened the supplementary air flues to their full extent, and found they did much better and continued to improve until we had a very satisfactory heat. The pit we found entirely too small—it extended only 6 feet back from the front of the benches, and gave the men no room to operate with suitable tools to remove the clinkers and take out the ashes. We also found it difficult to clean the air and smoke flues in so narrow a pit, showing the necessity for a wider one.

The other bench I fired with coke until I got a good white heat, and then used coal, experiencing no trouble. I continued to use coal from that time on almost entirely—occasionally using coke for a day or two at a time, when the wind was blowing from the south, as the smoke was very annoying to the residents living across the alley and just north of the retort house. The coke would keep a good heat, but the stokers preferred to use coal, as it required less attention. These benches I used continuously for 2 years and 1 month to 2 years and 4 months, when the last one was let down. During the time the benches were in use the charges averaged 325 pounds of coal to the retort, the length of time the charge remained in being 4 hours and 48 minutes. Each bench will use 1½ tons of coal per day for firing, or 7 bushels of coal for each ton of coal carbonized in retorts. The coal used in firing is mined within 1½ miles of the works, and is a fairly good steam coal.

Being so well pleased with the working of these benches and the results obtained, we decided to put in six more of the same size, with the express purpose of burning coal in the furnaces as fuel. Accordingly, in March, 1891, we contracted with the Laclede Firebrick & Manufacturing Company of St. Louis for six benches of six retorts each, known as the Mitchell bench; and to make room for them we at once commenced to tear out all the old benches, which were of three retorts each, plain, open setting, and a style that had been in use for the last twenty-five years, and without doubt had cost the Company a great deal of money, as they burned from one-half to two-thirds of all the coke produced to keep up the heat, and required much more labor to the retort than the benches now in use. The Mitchell bench is made with an arch 7 feet 8 inches wide by 9 feet 4 inches deep; the upright flues are 9 by 13 inches, and connect with a chimney 13 by 18 inches inside, extending through the roof. The arch is filled with 6 retorts, 15 by 26 inches and 9 feet deep, and are set with what is known as a self-supporting setting. The fire box is 4 feet deep, 18 inches wide, and extends back 4 feet at the top; the bottom being somewhat shorter, as the back end is made sloping. The furnace is fitted with 3 step grates or iron plates, which slope from the firing door to the grate-bars. On the top plate a small stream of water is admitted, and this drops from one plate to the other and then into the ashpan. By this the plates are kept cool, and some steam is generated, which serves to soften the clinkers. The furnace is equipped with primary and supplementary air flues. The smoke flues are connected from top to bottom with pipe or tile, which passes down through the air flues, and by this means the air passing into the furnace becomes intensely heated before entering. The front of the furnace is closed with a tightly-fitting door, with clamp and screw to fasten it. Profiting by the experience in working the other benches, I built a pit in front 10 feet wide and 7 feet high in the clear. This goes down 2½ feet below the ashpan to the floor, which enables the workmen to clinker and remove the ashes much easier than if the floor was on a level with the ashpans. The pit is covered or floored with perforated cast iron plates, supported by railroad rails, and is connected with the coke shed by a tunnel running about 30 feet through the yard. In drawing the retorts the coke falls directly into the pit and is caught in iron barrows, and is then removed to the coke shed. On the 8th day of September we commenced to fire the first of these benches, being careful to use coke for firing until we had obtained a good white heat, then using coal with very satisfactory results. I soon found pea coal would burn as well as lump, and, being much cheaper, I used that for some time; but later on I found that coal dirt or slack would give just as good results with very litte more labor—all it required being to stir it up with a bar two or three times between firing. This slack we now use entirely. It costs nothing but the hauling—1½ cents per bushel—and costs on an average 60 cents a day per bench. On the whole, I can say that we are well pleased with the results obtained with these benches, and I am sure they have resulted in a large saving to us since their introduction.

DISCUSSION.

THE PRESIDENT—Gentlemen, the paper is before you for discussion, and we would be glad to hear from a large number.

MR. JAS. W. DUNBAR—The results obtained by Mr. Odiorne in the consumption of coal are certainly wonderful. I desire to ask him if he is certain he is correct in his estimate that 1½ tons of slack coal, or pea coal, does the work. I also desire to know the yield per retort and per pound, and the kind of coal he uses.

MR. ODIORNE—We use slack coal, and have right along, and that is about an average. Some days when we charge heavier we burn probably a little more, and other days we burn less. The yield per retort is rather a difficult question to answer, inasmuch as sometimes we use half Pittsburgh coal and half native; the latter is a very inferior coal. Sometimes it is more than half one way, and less the other. However, when we are using Pittsburgh coal altogether we get about 8,000 to 9,000 feet, according to the size of the charges per retort. The yield per pound of Pittsburgh coal through the month is a little difficult to get at, inasmuch as we use cannel coal for an enricher, the cannel coal being put into separate retorts, and the gas, of course, goes altogether with the native coal, too. We have used at times all Pittsburgh coal and with very little cannel, and we then have a yield of 4.75 feet per pound. With our native coal the make runs about 3.25 feet per pound.

MR. TRACY—As Mr. Odiorne states he has torn out one of those furnaces, I would like to find out how he found the furnaces. Those benches cost considerable money to put in—I am running one myself, but not long enough to tear it out—and I would like to find out if his furnace was fit to put in another setting without tearing it to pieces.

MR. ODIORNE—We had constructed at the same time one bench for firing with coke on the same side as this bench for firing with coal., The two south benches I tore out, and was surprised to find them in such good condition. The other two benches on the other or north side of the retort house, put in at the same time, I left in. I am going to fix up the front a little bit, as it is somewhat worn, and use them again. The retorts look very well, and I think they will run me, anyway through another winter.

MR. TRACY—Do you think your furnaces will wear out several settings of retorts?

MR. ODIORNE—I do not know that I can say that. The furnaces are very good and the retorts are very good, and I am going to use the whole thing by patching up the front again.

MR. J. W. MURDOCK—My experience with coal fire benches is a little older than that of Mr. Odiorne. In 1888, while Sperintendent of the Huntsville (Ala.) works, I had put in, by the Laclede Fire Brick Company, two Mitchell benches of 5's, which were still running satisfactorily when I left there. In 1890 I had two Mitchell benches of 6's put in the Ottawa (Ills.) works, and have been running one or both constantly since then. I use nothing but slack coal for the furnaces and find that I can get any heat I want. Before working the Mitchell bench we could not get a better yield than about 3.20 cubic feet per pound of Streator (Ills.) coal, and our yield with the Mitchell bench, with the same coal, is about 4.10. Our retorts are 14 inches by 24 inches by 9 feet, and our highest make per bench in 24 hours was a little over 53,000 cubic feet, with Pittsburgh coal. I have a statement of this monthly make, showing results of one bench, to the 17th of May, and quantity of slack used in the furnace. We do not require more gas at present, or I could show better results, as I have made as high as 43,000 cubic feet with the same coal in 24 hours on this bench. The statement for the first 17 days of May is as follows:

Date.	Coal, Lbs.	Fuel Coal, Lbs.	Meter Statement.	Amount Gas Made.	Yield, Per Lb.
			2,910,300		
May 1	7,800	3,390	2,942,600	32,300	4.14
" 2	8,250	3,310	2,978,200	35,600	4.31
" 3	8,800	3,550	3,017,000	38,800	4.42
" 4 Yough Streator	3,100 6,250	3,530	3,056,200	39,200	4.10
" 5	8,800	3,690	3,094,300	38,100	4.33
" 6	9,350	3,275	3,132,400	38,100	4.07
" 6 Yough Streator	1,100 6,650	3,120	3,169,400	37,000	4.93
" 8	8,800	3,250	3,204,400	35,000	3.97
" 9	8,800	3,250	3,240,200	35,800	4.06
" 10	8,300	3,225	3,274,900	33,700	4.06
" 11	8,250	3,150	3,308,500	33,600	4.07
" 12	8,250	3,360	3,346,300	37,800	4.58
" 13	6,050	2,710	3,371,100	24,800	4.09
" 14	9,400	3,210	3,408,600	37,500	3.97
" 15	9,500	3,295	3,446,600	38,000	4.00
" 16	9,500	3,190	3,481,500	34,900	3.58
" 17	7,650	2,975	3,511,800	30,300	3.96

One of the two benches in Huntsville had been running 19 months when I left there. We run two benches during the winter, and let one down in the spring; and, so far as the setting is concerned, it is perfectly good. I may say that I think the setting is good for one or two more seasons. I started the bench on the 7th of March, 1891, and I have had no bother whatever with soot or the stopping of flues. I fired the first day and a half with coke, but from that on used coal. I fire with Streator slack—and it is nothing but slack. Its costs 95 cents per ton.

Mr. Geo. Treadway Thompson—We are running at present 30 benches of 5's, fired by the Mitchell furnace, of the same construction described, and have contracted for 10 benches of 6's in addition, for which we are now tearing out the settings in the present arches and preparing for new settings. Our experience in the use of the coal for firing has been that, on the average, about 1,350 pounds of Illinois nut coal will be required to do the work of 1,000 pounds of Pittsburgh gas coke. The Illinois nut coal we get delivered at our works at $1.10 a ton, and the coke costs us 6½ cents per bushel of 36 pounds. A comparison on that basis would be $1.75 for the coke as against 75 cents for the coal. That is about an average comparison. We have had some difficulty with the stoppage of flues from soot, but it has not been a difficulty which has given us any considerable trouble to overcome. About once every week we will change for a few hours from coal to coke in our furnaces, and that of itself is sufficient to clear the flues from soot. We have also an attachment of steam pipes along the range of benches, with which, by the use of a long iron pipe, bent at the end, we can blow out the "organ pipes," as Mr. Dell has called them—the pipes which carry the waste gases—and in that way keep them clear. No difficulty whatever is attendant upon the working of these benches, and their success is unquestionable.

Mr. Dunbar—I would like to ask Mr. Thompson what he usually obtains per retort, and whether his heat is as high with the slack coal as when working with coke.

Mr. Thompson—We are not now employing the slack coal but are using nut coal, which is a first-class steam coal. The heats are higher than they were when using free fire furnaces, but no higher than they would be with coke in the same furnace. Our retorts are very much smaller than those which Mr. Odiorne employs. Ours are 14 inches by 22 inches by 8 feet, 3 inches—quite small retorts. We charge from 290 to 300 pounds per retort. Our yield will vary from 5 feet to 5.20 feet. That is, we employ oil for enriching our gas. The yield per retort will figure from 8,000 to 9,000 feet per day, and sometimes a little higher.

Mr. Lynn—I have had some little experience with the Mitchell bench. We ran then at Evansville for almost two years. We obtained results which I suppose are about the best ever obtained by any Mitchell bench run at that time. We used on an average 2,500 pounds of coal per bench in 24 hours to do the work, carbonizing a weight of coal that required 60 bushels of coke in the ordinary bridge wall setting. This coke was worth 7 cents a bushel, representing a saving of $4.20. The coal that we used to fire the benches with was a native coal from Indiana, costing $1 a ton, laid down in the works. This would make the coal cost $1.25, showing a saving for the coal over the coke of $2.95 per diem. I carbonized 2,200 pounds of coal in six retorts every four hours. My retorts were extra large—they were 17 inches by 30 inches, by 10 feet long, in the clear, and my average yield with Youghiogheny coal was about 4.80. We never tried to get more than 4.80 out of that coal. We were using no enricher at that time, and when you get over 4.80 out of the coal you reduce your candle power accordingly.

Mr. Dunbar—I wish to ask Mr. Odiorne the appearance of his furnace when he is burning the slack. Does he have an intense heat in the furnace or simply a small heat and generate the carbonic oxide and burn that by his secondary air? When you open your fire door what is the appearance of the heat in the furnace?

Mr. Odiorne—If the fire is left in there for about an hour it is very hot.

Mr. Dunbar—I have reference to the pea coal itself. Does that get very hot?

Mr. Odiorne—It gets very hot at the back end of the furnace, but not in front.

Mr. Tracy—I have been using nut coal and find I get a better heat with that at 90 cents a ton than I do from coke.

Mr. Thompson—Mr. Lynn speaks of 60 bushels of coke to do the work of 2,500 pounds of coal. How many pounds per bushel?

Mr. Lynn—Forty pounds.

Mr. Jenkins—You do not consume all your smoke?

Mr. Odiorne—That is a fact; no, sir.

Mr. Jenkins—Does it make a very bad nuisance to your neighbors, if the wind is in their direction?

Mr. Odiorne—Yes; the smoke rolls out in large volumes for 8 or 10 minutes after firing. From that on we get very little smoke.

Mr. Jenkins—Just at the first of the firing?

Mr. Odiorne—Yes.

Mr. Jenkins—I wonder if you could not consume your smoke? I do not get very cheap coal. Right opposite our works is a large boarding-house sheltering about forty persons, and if the smoke should happen to go over there I imagine I would hear from them.

Mr. Odiorne—It takes about five minutes to do our clinkering. We clinker, however, four times a day. We take out the ashes four times a day and do the clinkering without using supplementary bars. The coal cokes together and forms a bridge in the furnace, and we pull out all the old ashes and clinkers; it comes out easily.

Mr. Dunbar—Do you find the Mitchell bench to be adapted for the use of pea coal; that is for firing?

Mr. Odiorne—I find very little difference in using pea coal or slack. This slack is very fine—as fine as wheat or finer. In using either pea coal or nut coal, or even large coal, you can see very little difference. Our men would just as soon fire with slack as with anything else.

Mr. Lynn—This seems to be a paper gotten up for the Mitchell benches. Now, Mr. Odiorne has used the Parker-Russell half-depth regenerative bench, and I would like to ask him the comparative results obtained from the two furnaces. When he put in the Mitchell benches I gave him my experience and he gave me his, at that time, and I would like to have his experience in comparing the two benches.

Mr. Odiorne—I was so well pleased with the Parker-Russell benches that it was a matter of dollars and cents with me when I contracted for more benches, and have since contracted for four benches of the Parker-Russell pattern.

Mr. Gwynn—I would like to ask Mr. Odiorne how he clinkers when he uses coke for firing these benches.

Mr. Odiorne—Four times in 24 hours; the same time. We do not take all our fire out, you understand; we simply take all the ashes and loose clinkers out.

Mr. Tracy—I clinker every other day, but I do not put my men down in that pit only every other day. We shake it up and take the ashes out. I find no trouble on the days we do not touch it at all—just shake it up; and on those days we have had the best heat and make the most gas. (Laughter.)

THE PRESIDENT—Why don't you let it alone altogether?

MR. ODIORNE—It is a fact that the oftener you clinker, provided you remove a good mass of the fire, of course your heat goes down. In our method of clinkering I do it very quickly; as I say, it does not take more than five minutes. The furnace is up so high from the floor of the pit that a man can work very rapidly. It takes him a very short time, and consequently we do not lose the heat we would if we pulled everything out—both clinkers and heated fuel.

THE PRESIDENT—I understand that Mr. Printz has had some experience in clinkering, and we would like to hear from him.

MR. PRINTZ—I cannot say that I have had a very large experience in clinkering, for we only clinker once in about 4 to 6 months, and then we only clinker so as to not forget how. (Laughter.) I was going to ask Mr. Odiorne how often it is necessary to fire the furnaces with coal? And I want to ask the same question that was asked a few minutes ago in regard to the smoke nuisance. He says that the smoke rolls out considerably for a short time, and after that but little. What is this that he speaks of as not much? Is it just a little blue smoke that would not give any trouble, or would it be something that would be complained of on the part of the neighbors?

MR. ODIORNE—In answer to the smoke nuisance question, I will say that, in probably 15 or 20 minutes after firing, if you look up to the top of the stack you can see hardly anything coming out at all. You can see the heat radiating, but no smoke.

MR. PRINTZ—How often do you have to fire?

MR. ODIORNE—We fire once an hour. When we fire we just take a bar and run through the slack to loosen it up. If we want a little more heat, in burning off large charges, we shake that up two, or possibly three times between fires in order to let it burn a little more freely.

MR. DUNBAR—What are the dimensions of the furnace?

MR. ODIORNE—Four feet deep and 18 inches wide at the grate bars. It slopes back at the rear end.

MR. LYNN—Are not your furnaces 18 inches wide only at the grate bars, and do they not slope after passing the grate bars?

MR. ODIORNE—Yes; it is 18 inches at the grate bars, and widens to 34 inches.

MR. GWYNN—I would like to ask Mr. Odiorne if it is uncomfortably hot in clinkering with the furnace?

MR. ODIORNE—When we constructed these benches the men complained that they would be too hot, but they found that section to be one of the coolest places about the retort house, from the circulation of air about there. It is not at all hot, and they do not complain at all.

Mr. Gwynn—I think it would be well enough for the makers and constructors of these furnaces to adopt, if possible, some method of firing them, perhaps similar in construction to the Roney mechanical stokers, in order to get rid of this smoke.

Mr. Highlands—One matter that has not been touched upon very much in this discussion—this has been to me a most interesting discussion, and one of my reasons for coming was to listen to it—is in regard to the Streator coal. What do you do with the coke? Is it worth anything? How do you obtain the candle power? and what illuminating power does it give your gas?

Mr. Murdock—Our candle power was from 18 to 18½ candles.

Mr. Highlands—Is the Streator coke a hard, firm coke as it comes out?

Mr. Murdock—It is certainly quite as hard as that from Youghiogheny coal. It is good coal.

Mr. Highlands—Does it yield a coke good enough to fire the furnace with?

Mr. Murdock—Yes; we used it to fire with altogether before we put in the Mitchell furnace.

Mr. Highlands—Do you use any enricher?

Mr. Murdock—No; our Streator coal will make a richer gas than the Youghiogheny coal.

Mr. Highlands—A year ago I abandoned the use of coal gas and put in a water gas process, but since the increase in price of hard coal, we little fellows in the west feel like turning to something else, in case of an emergency at least; and for that reason I hope this discussion will not close until the matter is a little better ventilated.

Mr. Thompson—The gentleman from Ottawa, Ills., said he made something over 4.20 per pound.

Mr. Murdock—Yes.

Mr. Thompson—Of 18½ candles?

Mr. Murdock—I might better say 17 to 18½ candles.

Mr. Thompson—By what photometer was that measured?

Mr. Murdock—By the Jones' jet. (Laughter.)

The President—I used some Streator coal, and on a very careful test found the gas to be fully 18-candle power. The yield was small; I think, about 4.50 or 4.60.

Mr. Thompson—In handling our furnaces, while we clinker twice in 24 hours, we remove the ashes and generally slightly shake up or clean the fire six times altogether. Our retort house is of the stage floor pattern, and the furnaces are handled from a staging or carriage running a height of some 8 feet above the cellar floor, or some 6 feet beneath the stage floor—the level of the charging floor. One man will attend to 10 furnaces, doing the work of clinkering and adjusting the water and air ports, when necessary, the firing, however, being done from above. We fire about once an hour, as Mr. Odiorne does.

MR. F. M. DOAN—As I understand you, Mr. President, you stated a moment ago that you had used the Streator coal. What was your yield per pound?

THE PRESIDENT—I don't remember exactly, but think it was about 4.50.

MR. DOAN—That is certainly remarkable.

THE PRESIDENT—It was supposed to be the best quality of Streator coal. The coke we considered poor; so poor, in fact, that we would not think of using any more of the coal.

MR. GWYNN—Mr. Odiorne speaks of enriching with cannel coal. Did you ever try to burn the cannel coal coke in your furnace?

MR. ODIORNE—Yes; I have burned it in the furnace—sometimes when we ran short of slack we used it, and it went very well. The most of the time we used the coke from the cannel coal under our boilers, and the men liked to use it. It makes a slow fire.

MR. GWYNN—Did you notice that it made any increase in the clinkers when you used it in the furnace?

MR. ODIORNE—Yes; it did.

THE PRESIDENT—I would answer the gentleman's question a little further concerning the coke. We could not keep up the heat by carbonizing the Streator coal with its own coke. We had to charge, in a portion of our works, Pennsylvania coal in order to get coke to keep up the heats to the point of burning off the Streator coal.

MR. DELL—There has been a great deal said about this Mitchell bench, and I hope you will pardon me for making a remark in connection with it. This firing with coal seems to be looked upon as a new thing. It is not new, however, for Mr. Mitchell has used it for about 10 years at his works.

MR. LANSDEN—I move a vote of thanks to Mr. Odiorne for his excellent paper.

THE PRESIDENT—I think Mr. Odiorne may consider himself duly thanked without putting the question. We will now listen to the paper by Mr. A. E. Forstall of Newark, N. J., on

THE ORIGIN OF COAL AND PETROLEUM.

As Mr. Forstall was not able to be with us Mr. Ramsdell has very kindly consented to read the paper. Mr. Ramsdell read as follows:

The average gas engineer finds his time so fully taken up by the routine of his position, or by investigations bearing directly upon the improvement of the processes with which he had to deal, that he has little leisure for original research in outside fields. When, therefore, the wisdom of the "powers that be" in the Western Association assigns such a subject as this for a paper, there surely can be no expectation of the development of any new and startling facts or theories. The idea must rather be to obtain a summary of facts and theories already known to and advanced by geologists, with a brief, succint, statement of the arguments for and against these various beliefs. It is from this standpoint that what follows has been written.

Geology is, from the nature of things, an indefinite science, in so far as it deals with the earlier periods of the earth's existence. Studying the effects produced by natural forces at the present day, it reasons that the past similar effects argue the operation of the same forces. But even the record of these effects as contained in the portions of the earth's crust explored by the geologist is very incomplete, many gaps being left to be filled in by deduction, always liable to error. Any moment may bring forth some new fact, upsetting preconceived ideas and compelling a remodeling of theories. However, the theory as to the formation of coal now generally held is apparently as firmly founded as any geological speculation, and will probably never have to be materially altered. That in regard to petroleum is not so certain, but accounting satisfactorily for all the facts as known, must be accepted until some new and irreconcilable discovery is made.

Let us take up coal first. Almost all the coal known to and worked by man dates from the Carboniferous Age division of the Paleozoic Period, taking its name from the extent of its coal formations, and itself capable of sub-division into three minor periods; the Sub-Carboniferous, the Carboniferous proper and the Permian. It is in the measures of the second of these subdivisions that coal is principally found, in seams varying from a fraction of an inch to 40 or 50 feet in thickness. Under each coal seam is a bed of fire-clay; above it a covering of black bituminous slate. A pure, simple seam is rarely more than 8 to 10 feet thick, the mammoth seams being formed by the running together of several seams through the thinning out of the intermediate strata, which are still to be found in very thin layers through these seams. Between the seams, with their accompanying clays and black slate, are layers of sand and lime stones. A section through the coal-measures shows a number of seams of coal, in some cases as many as 50 or 60, of various thicknesses and degrees of purity, separated from each other by intervening strata of sandstone and limestone. The vegetable origin of coal is no longer considered doubtful, and quoting from Le Conte's "Elements of Geology," we have the following as the principal evidence upon which is based the present scientific unanimity of opinion on the subject:

"*First.*—The remains of an extinct vegetation are found in abundance in immediate connection with the coal seams, stumps and roots in the under clay and leaves and stems in the black slate in contact with the seam, and even imbedded in the seam itself.

"*Second.*—These vegetable remains are not only associated with the seam, but have often themselves become coal, though still retaining their original form and structure.

"*Third.*—Not only these easily recognizable imbedded fragments, but the imbedding substance also, the whole coal seam, even the most structureless portions and the hardest varieties, such as anthracite, when carefully prepared in a suitable manner and examined with the microscope, show vegetable cells with characteristic markings.

"*Fourth.*—A perfect gradation may be traced from wood or peat on the one hand, through brown coal, lignite and bituminous coal, to the most structureless anthracite and graphite on the other, showing that these are all different terms of the same series. In chemical composition, too, the same series may be traced.

"*Fifth.*—The best and most structureless peat, by hydraulic pressure, may be made into a substance having many of the qualities and uses of coal."

These are, in brief, the main reasons for the belief in the vegetable origin of coal. Working on this hypothesis, how can we account for the different varieties of coal, classified according to their elementary composition; that is, according to the relative amounts of carbon, hydrogen and oxygen contained in them, these being the three elements forming a pure coal? The substance that makes up the mass of the cell membranes of all plants is called Cellulose, and has a composition denoted by the chemical formula, $C_{18}H_{30}O_{15}$, signifying that each molecule is formed of 18 atoms of carbon, 30 atoms of hydrogen and 15 atoms of oxygen. When vegetable matter is protected from contact with air, as it may be by being covered with water, mud, or a growth of fresh vegetation above it, a slow decomposition takes place by mutual reactions among its own elements. Carbon unites with hydrogen to form marsh gas, CH_4; also with oxygen, forming carbonic acid, CO_2, while hydrogen and oxygen unite, producing water, H_2O. These reactions are proved to take place by the continual giving off of marsh gas and carbonic acid from the coal in mines, these two gases being the fire-damp and choke-damp, so dreaded by miners. Analysis also shows that the bubbles, which rise to the surface when we stir up the decaying vegetable matter at the bottom of a pond, are composed of these gases.

Starting now with 2 molecules of Cellulose, or $C_{36}H_{60}O_{30}$, by subtracting 9 molecules of CO_2, 3 of CH_4. and 11 of H_2O, we have left $C_{24}H_{26}O$—the formula for an average cannel coal. In the same way we obtain $C_{26}H_{20}O_2$—the formula for average bituminous coal—by the subtraction of 7 molecules of CO_2, 3 of CH_4, and 14 of H_2O; and finally if we deduct 10 CO_2, 10 CH_4, and 10 H_2O, we have left C_6, which is pure carbon or graphite. Thus reactions known to occur are shown to be capable of producing coal from vegetable matter, another strong argument in favor of this theory.

It is almost certain that bituminous coal has been formed in the manner indicated from the original vegetable matter, without the aid of heat, the strata found with it showing no signs of metamorphism.

The extreme varieties of coal, anthracite and graphite, are always found, however, associated with the metamorphic rocks, so that it is almost equally certain that in their case heat has played a part in the complete expulsion of the hydrogen and oxygen. Such heat need not be extreme, a temperature of 300° to 400° F. being sufficient to produce all the metamorphic effects found in the anthracite regions.

The origin of the coal thus determined, how can its accumulation in its present form of numerous seams throughout the coal-measures be accounted for? This accumulation certainly took place in the presence of water. In no other way can the preservation of the original organic matter which would have decayed if left exposed to the atmosphere, the presence of interstratified layers of clay, sand and limestone, or the stratification of the coal itself, be explained. Besides the plants found in connection with the coal seams are such as grow in moist ground. Opinion, however, is divided as to whether the growth and deposition took place on the same spot, or whether the latter occurred at a distance from the original home of the plants, being brought about by the formation at the mouths of rivers of the so-called "rafts," an example of which is found at the mouth of the Red River. The theory of growth *in situ* seems most probable, agreeing better with the facts of the comparative freedom of coal from ash, which is intermixed inorganic matter; the existence on top of the seams of numerous perfect specimens of the most delicate parts of plants, and the number of stumps found apparently in the exact condition and position in which they grew in the underclay.

The study of the strata of the coal measures seems also to indicate that the forests, from which the larger coal beds have been formed, grew at the mouths of rivers, on low lands more or less marshy and subject to overflows from the rivers, with occasionally an incursion of the sea due to a gradual subsidence of the continent. The land area of the earth bearing then a much smaller proportion to the water than it does at the present day, the air was saturated with moisture and consequently the climate was much warmer and more equable; water vapor, from its property of allowing luminous heat rays to pass almost untouched, while almost completely absorbing the dark rays radiated back from the earth, being one of the potent agents in storing up in the earth the heat coming from the sun. These conditions of constant moist warmth, coupled with the presence of an excess of carbonic acid in the atmosphere, produced a most luxuriant forest growth, continuing for years and forming a constantly thickening deposit of vegetable matter. Now and then an overflow of the river covered this deposit with a thin layer of sand and mud, on top of which a new seam began to form. At longer intervals an inrush of the sea put an end to vegetation and formed a stratum of limestone. But gradually the sediment brought down by the rivers built up on the sea bottom new deltas on which a new growth began and the process was repeated.

Thus, by the alternate growth and submergence of vast forests, were the materials destined to produce these deposits of incalculable value formed and stored under the conditions necessary to their future transformation. Slowly, during the thousands of years of the carboniferous period, did the energy of the sun transform the carbonic acid of the atmosphere into solid carbon; still more slowly through the succeeding eras came the changes bringing this carbon to its present form, and now, after ages of preparation, man is "unbottling the sunshine," modifying the rigors of winter and turning night into day with the rays apparently lost millions of years ago.

Turning to petroleum, we find opinion much more divided, and no such general knowledge of the subject as to warrant implicit belief in any particular theory. The various theories may be divided into two classes: those asserting a derivation from the chemical reactions of minerals or inorganic matter, and those claiming an organic origin through the decomposition of vegetable or animal matter.

The theories of Berthelot or Mendeljeff are leading examples of the first group. According to the former, petroleum is formed by the action of water, carrying carbonic acid in solution, upon alkali metals existing in a free state and at a high temperature in the center of the earth, he having pointed out the reactions that would take place resulting in the formation of hydrocarbon compounds.

Mendeljeff's theory supposes the existence in the interior of the earth of metallic iron and metallic carbides at a high temperature, which, by contact with water, would generate metallic oxides and hydrocarbon compounds.

Both theories consider the production of petroleum as continuous, the vapors rising as they are formed and condensing to liquids in the porous strata of the oil-fields, thus making the supply inexhaustible as long as the necessary minerals and water exist.

But these theories, though chemically perfect, are not generally accepted by geologists, since they do not accord with geological facts, which point more to the organic origin of petroleum; that is, to its derivation from the decomposition of vegetable or animal matter originally contained in the rocks in which it is found, or in closely associated strata. As we saw in considering coal, the decay of vegetation at ordinary temperatures, when taking place out of contact with air, produces marsh gas. Peat bogs yield inflammable gases, and sometimes also members of the bitumen series closely allied to petroleum and asphalt, thus showing the decomposition of organic matter to be competent to produce petroleum.

There are two views as to this method of decomposition: one, that it is a primary decomposition of organic matter in or associated with the strata where the oil is found—the production, therefore being *in situ;* the other, that a primary decomposition of the organic matter to hydrocarbon compounds first takes place, from which compounds oil and gas are derived by distillation and carried by hydrostatic pressure to the overlying porous strata, which act as reservoirs.

The chief exponent of the theory of primary decomposition is Prof. T. S. Hunt, who holds that petroleum is principally derived from animal remains contained in limestone rocks, though he admits a few cases of vegetable origin.

The theory of distillation is most fully stated by S. F. Peckham, in the report on petroleum, contained in the tenth volume of the "Special Reports of the U. S. Census of 1880." He considers that petroleum was formed by distillation principally from beds of shale containing fucoid plants and animal remains, with limestone as a minor source, basing this view upon the variations in composition of petroleum found in different portions of the same field, which he thinks can only be accounted for upon the theory of fractional distillation. In the case of the Pennsylvania oil field, the oil is derived principally from vegetable remains in rocks far below the present level of oil occurrence, the heat for its distillation having been supplied by the causes that resulted in the upheaval of the Appalachian mountain system, and the evidences of this heat are to be found deep down beneath the unaltered rocks in which the petroleum is now stored. Peckham also considers the occurrence of large veins of solid bitumen in fissures and metamorphic rocks as a further proof of the fact of distillation.

In Vol. VI. of the "Reports of the Geological Survey of Ohio," Prof. Edward Orton, the State Geologist, discusses the subject of the origin of petroleum quite extensively, reviewing the various theories given above, indicating their weak points, and stating his own views, derived from a special study of the Ohio fields in connection with a general study of the whole subject. Admitting the great want of definite information that prevents any theory from being accepted as perfect, he inclines toward the idea of primary decomposition as the great factor in the production of petroleum, a decomposition including both vegetable and animal matter, according to location. Thus the large amounts of nitrogen and sulphur in the Lima and California oils—the unstable character of the latter and their presence in limestones filled with animal remains, are strong proofs of an animal origin. These limestone oils are dark and heavy, with a rank odor, and are easily distinguished from the oils of a probable vegetable origin, such as the Pennsylvania type, coming from bituminous shales and found in sandstones.

As an argument against the theory of distillation, Prof. Orton cites the fact that the study of the rocks underlying the Ohio oil fields, by means of borings carried 1,800 feet below the oil-bearing strata, shows no signs of metamorphism, which, as the depth is below the only known source of oil supply of the Pennsylvania type, would seem to condemn the idea of distillation. In favor of the theory of primary decomposition, he notes the fact that, at the present day, in Trinidad, beds of slate formed in comparatively recent times beneath the sea, but now raised above its level and containing abundant vegetable remains, are yielding petroleum in large quantities by direct decomposition of vegetable tissues, this petroleum passing into ashpalt as a result of exposure to the atmosphere. But if the action took place where the petroleum could be stored out of contact with the air it would remain as petroleum. This is what has happened in the oil fields. A tropical climate seems necessary for this action.

Applying the views derived from the foregoing facts to explain the origin of the oil of Eastern Ohio and Pennsylvania, the following theory is worked out: These fields were the site of a tropical sea, upon the floor of which the shales constituting the chief source of the oil were accumulated. The rivers emptying into this sea laid down sedimentary deposits of clay and sand, with occasional gravel bars. In the sea itself was a vast development of marine vegetation. Some of the especially abundant plants had very resinous spores and spore cases, which were set free in enormous quantities, and, in connection with other portions of these and similar plants, were carried to the bottom in a macerated condition, there to pass through the coaly transformation, resulting in the structureless carbonaceous matter that constantly characterizes black shales, and that can still be made to yield by destructive distillation members of the bitumen series. The shales, thus slowly accumulated at the bottom of this gulf, must have behaved as similar shales do now, petroleum and bitumen being formed as in the case of the Trinidad shales. The petroleum was absorbed by the particles of clay in contact with it, or if formed in the water was caught by floating particles (clay possessing the property of absorbing oils in a marked degree), being carried by them to the floor of the sea as the sediment deposited. This process continued until the materials were exhausted, producing a shale much richer in petroleum than any portion of it is at the present time. Over this was laid a bed of porous sandstone, saturated with sea water and roofed in by a very fine-grained shale. Then, by a slow system of exchange between sandstone and shale, the oil reached its final reservoir.

Prof. Orton claims that this theory finds more support in the present process of nature than that of distillation, as we see the bitumen series forming to-day by the apparent primary decomposition of organic matter under normal conditions, while on the other hand we do not find this series in any case open to observation and measurement as a result of secondary decomposition, unless the comparatively high temperatures of destructive distillation are reached. Still he admits that every theory in regard to petroleum is merely provisional, and none can be accepted as final. He summarizes his views as follows:

First.—Petroleum is derived from organic matter.

Second.—It is more largely derived from vegetable than from animal matter.

Third.—The oils of the Pennsylvania type result from the organic matter of bituminous shales; that is, they are of vegetable origin.

Fourth.—The oils of the Canada or Lima type are derived from the organic matter in limestones, and are therefore probably of animal origin.

Fifth.—Oil was produced at normal rock temperatures; that of the Ohio field at any rate certainly not being the result of a destructive distillation of bituminous shales.

Sixth.—The stock in the rocks is practically complete, for though the production is still going on the rate is so slow as to make no appreciable increase in the amount already produced, in any ordinary space of time.

Prof. Orton's views have been given thus fully because he is the latest writer on the subject, and his ideas, being based upon a broad study of the whole field, are probably the most reliable. But according to his own statement the final word cannot yet be said as to the origin of petroleum.

From what precedes, it is seen that though coal and petroleum are of similar, they are not of the *same* origin; are not necessarily correlative; nor is petroleum a product of the transformation of vegetable matter into coal. The difference in the product of the two operations, one being a solid in all stages of its transformation, while the other is a very volatile liquid, may account for the greater certainty with which the record of the first can be traced through all its successive steps, and the almost total absence of record in the case of the second. As more is learned, however, by the development of new oil territory, and a more systematic study of the facts revealed by the drill, the theories of the origin of petroleum may be put upon as firm a basis as those relating to coal. Until then the gas man must accept the dicta of geological oracles, and keep at the, to him, more important task of working out the best method for the destruction of petroleum, without being absolutely certain as to its origin.

DISCUSSION.

THE PRESIDENT—Gentlemen, this is certainly not only a very interesting paper but a very ably written one as well—one that we will heartily thank Mr. Forstall for. I do not think it is a paper that will require very much discussion, but if any one desires to make any remarks upon it, we will be glad to hear them.

MR. HARPER—In two places in this paper, I think that possibly the word slate is used instead of the word shale.

MR. CLARK—I think it would be dangerous to change that to shale. Shale might fit the case, but so does slate. I would like to ask some more learned gentleman if a bituminous shale is not a slate.

MR. SOMERVILLE—No.

MR. EGNER—Mr. Forstall has acquitted himself very creditably with this subject, and I will move that a vote of thanks be tendered him.

Mr. Somerville—I do not see the need of cutting things off so quickly as that. I was about to say something in regard to the end of his description of the coal formation. It is as follows: "Still more slowly through the succeeding eras came the changes bringing this carbon to its present form, and now, after ages of preparation, man is unbottling the sunshine, modifying the rigors of winter, and turning night into day with the rays apparently lost millions of years ago." I think he might have added that we are also engaged in taking the nitrogen which entered into the plant life at that period out in the form of ammonia and putting it back to the ground again and so performing a beautiful function, which I think was lost sight of here. And I was simply going to say something, which I think Mr. Egner had in his mind, that this is a paper that does our young friend Mr. Forstall a great deal of credit. It is a paper that will be invaluable for reference.

Mr. Egner—I would also add, Mr. President, that it is a lesson for the members of this Association. It shows what one can do when a subject is assigned to him. The subject of the paper is one which probably might not have been exactly the thing to bring before this Association, and I should think, from the opening and closing lines of the paper, that Mr. Forstall is of the same opinion. A more practical subject would have elicited more criticism and discussion, but he has certainly given us a most admirable paper.

The President—I will say that when the paper committee considered this matter they deemed it would be impossible to find any one who would be willing to write on that subject, and I think we should be exceptionally thankful to Mr. Forstall for his efforts. A motion has been made that a vote of thanks be tendered him. I now put it to the convention. (The motion was unanimously carried.) One matter needs attention this morning before we adjourn. The report of the Committee on the President's Address carries with it a recommendation that a change be made in the By-Laws. The By-Laws at present read: "Any proposition to alter or repeal an existing By-Law shall be presented in writing on the first day of an annual meeting, seconded by not less than three members, shall lie over until the next day and be read again, and if approved by two-thirds of all the members present shall become a part of these By-Laws." I will say that on account of the report of this Committee not coming in yesterday, it was impossible to read it at that time, but unless objection is made it will be considered that this amendment was read yesterday, and we will now read it a second time for your acceptance. Of course, it is understood that only active members can vote on this question, and it will require a two-thirds vote. The Secretary will please read it.

The Secretary—The following amendment is respectfully submitted for the consideration of the members of this Association as supplementary to Section I. of Article VII. of our by-laws: "When, in the judgment of a majority of the Board of Directors, it shall be deemed advisable to change the place or date of meeting, or both, as designated by the Association at its last annual meeting, they shall have power to make such change or changes."

MR. LANDSDEN moved the adoption of the amendment; which motion was seconded by Messrs. Gwynn, Ramsdell and Egner.

MR. HUMPHREYS—I move we suspend the by-law, Section I. of Art. XIII., for the consideration of the question therein referred to. (Seconded and adopted.)

The motion to adopt the amendment was then agreed to.

The Association then adjourned until 1:30 o'clock P.M.

SECOND DAY—AFTERNOON SESSION.

The President announced that the business in order was the reading of the paper, by Mr. B. E. Chollar of St. Louis, entitled

PRACTICAL PHOTOMETRY SIMPLIFIED FOR DAILY USE.

Year by year, slowly but surely, with the growing wealth of the people, the continually increasing supply of surplus capital, and the consequent sharpening competition in all lines of business, involving large sums of money, the margin of profit in the gas-making industry is gradually diminishing. Gas to-day is sold in many places for less than the cost of making it twenty years ago, and the day is not far distant when a limit will be reached that will permit no further reduction in price.

If, when that day comes, an end to the demand for cheaper gas would come with it, the conditions might be endurable; but such will not be the case; the people of twenty years hence will be like the people of to-day—the clamor for cheaper lights will be as loud and as persistent as ever, and the purveyors of gas will be constrained to choose between the closest profit or some means of increasing the efficiency of their product that shall make it of more value to their patrons.

In electric lighting, increase of efficiency means increase in cost of lamps; the greater the economy of energy, the shorter the life of the lamp. In gas lighting, increase of efficiency means no loss, but only care and attention with comparatively slight expense.

The common gas tips of to-day will be the popular burners for many years to come; and if a reasonable amount of thorough and systematic attention to the duty performed by them can be made to effect a large increase in the light they develop, the result will be a probability of holding the present and increasing future business, which is equivalent to an increase of profit. If, without cost to our consumers, we can enhance the value of the services that our goods render to them, they will by that extent be more likely to remain with us. It matters not to them whether such result be effected by reduction in price, improvement in quality, or a means of using the same quality to better advantage.

The latter plan affords a good field for profitable work by gas companies, for the reason that much can be done at little cost. This is easy to understand, when we consider that with common coal gas the lighting service is all obtained from about 6 per cent. of its volume; hence a destruction of two of these parts, or only 2 per cent. of the whole volume, by reason of unsuitable or badly adjusted burners, will effect a loss of one-third or more of the available light. So freely can the light-yielding compounds be consumed without furnishing their due proportion of light, it is by no means an extravagant statement to say that the average gas burner develops less than two-thirds the light that may be expected of it.

The following are notes of experiments made with common lava tip E. H. burners. The gas was 18 candle power, and the standard a Sugg London D Argand with 24 holes, regulated to consume exactly 5 feet per hour. The standard burner was in good order and the chimney clean. The lava tips were all new, clean and in perfect condition. The efficiency of the standard burner was considered to be 100; the efficiency of the other was computed in terms more or less than 100, according as they developed more or less light, cost for cost, than the standard:

	Feet per Hour.	Efficiency.
A No. 1 tip	4.8	62
ditto	2.9	51½
ditto	2.5	49
ditto	1.7	47
A No. 2 tip	10.0	66
ditto	9.3	69
ditto	5.8	75
ditto	3.6	83
ditto	2.3	81
A No. 3 tip	10.2	71
ditto	7.6	75
ditto	5.0	94
ditto	3.6	89
ditto	3.0	89
ditto	2.3	80
A No. 4 tip	11.0	93
ditto	6.7	92½
ditto	5.0	94
ditto	3.0	91
ditto	2.2	87
A No. 5 tip	13.2	86
ditto	7.4	96
ditto	5.1	99
ditto	3.3	90
A No. 6 tip	14.2	94
ditto	9.2	102
ditto	5.8	100
ditto	4.8	100
ditto	2.8	84
A No. 7 tip	16.0	96
ditto	10.0	101
ditto	6.5	102
ditto	7.0	103
ditto	4.0	94
A No. 8 tip	16.6	98
ditto	11.4	103½
ditto	8.0	106
ditto	4.8	100
A No. 10 tip	17.4	95
ditto	12.8	104
ditto	9.4	100
ditto	6.2	96
No. 30 "Standard"	18.2	103
ditto	13.0	108
ditto	8.7	104½
ditto	7.5	104

Tips nominally of the same size and capacity are not always equally well suited to the same gas. For instance: One particular No. 10 tip, at 11.2 feet per hour, gave 160 per cent. more light than the standard argand at 5 feet, or an efficiency of 116. The same burner at 11.4 feet gave 200 per cent. more light than the standard, or an efficiency of 132; while at 11.6 feet it developed 220 per cent. more, or an efficiency of 132. In the latter case the gas consumed with a burner that costs 3 cents was worth one-third more to the consumer than when burned with the expensive argand. With old and dirty burners, especially when enclosed in dusty globes, we will see by the following that the unnecessary loss of light is enormous; they are experiments made for consumers who complained of the quality of the gas.

A tip burning 3.7 feet per hour gave an efficiency of 38, or reduced the value of 18-candle gas to 6.8 candles.

A No. 3 tip at at 4.5 feet gave an efficiency of 41, or reduced the gas to 7.4 candles.

A tip consuming 7.2 feet per hour and developing an efficiency of 33 was replaced by another that gave 70 per cent. more light at 7 feet per hour.

A No. 3 tip in an opal globe gave an efficiency of only 13—the illuminating power of the 18-candle gas was reduced to less than 2½ candles.

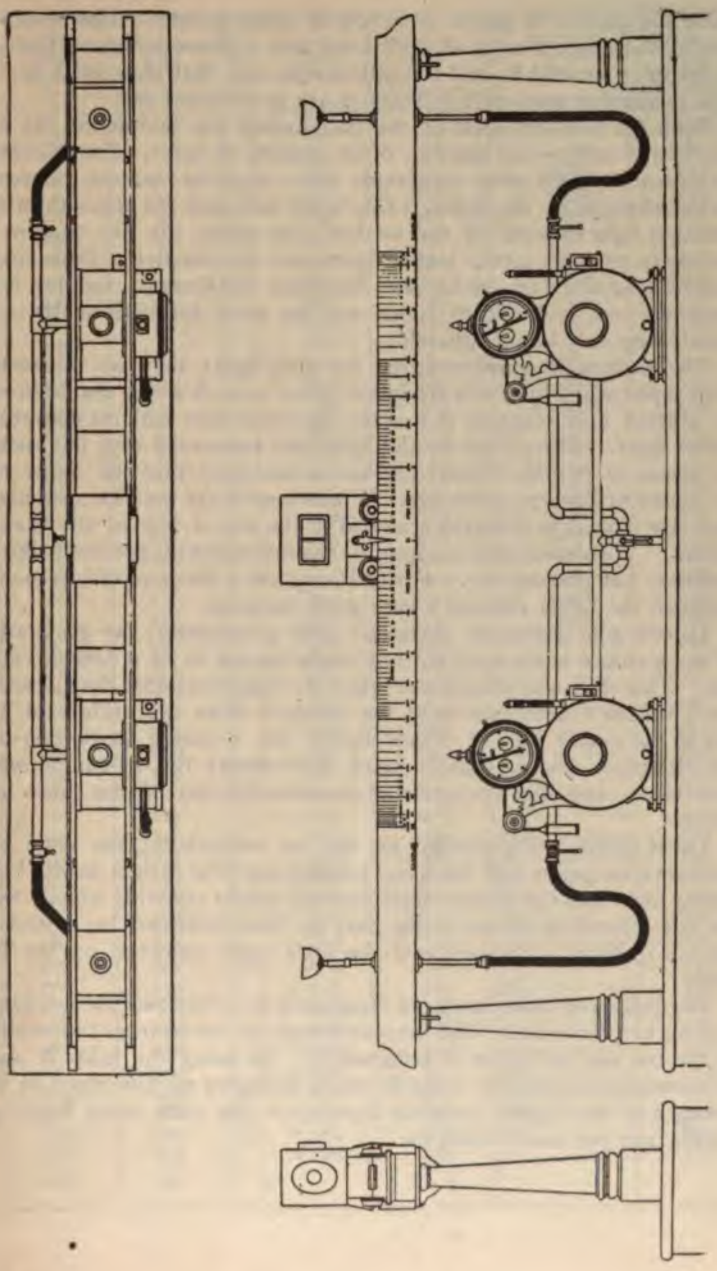
Another, a No. 4 tip in an opal globe, gave an efficiency of only 20. The consumer was reducing the candle power to $3\frac{6}{10}$, and paying a dollar for the same light that he might have had for 20 cents.

Gas consumers purchase gas for the light it affords. The cost of a required amount of lighting is what they look at, but they give little attention to economical methods of using the article; nor can they reasonably be expected to do so. As long as gas supplies them with what they consider to be the most satisfactory light for their requirements, just so long will they remain patrons of gas companies; but, when some other light is brought to their notice that strikes them more favorably, they will adopt it to the exclusion of gas.

To develop the best light comes within the field of the gas company as much as to furnish the best quality of gas at the lowest price. We can talk about "educating" our customers to take care of their burners and fixtures, but it will do no good—they will not do it. A consumer's interest in the question is only individual, while the gas company's interest is the aggregate of the consumer's interests, and whatever effective work is to be done in this line must be done by the gas companies.

The requirements for a systematic development of the efficiency of gas for lighting purposes are few; a specially constructed photometer and a good deal of work with it being the chief requisites.

Heretofore the use of the photometer has been principally to deter-



mine the quality of gas as an article of manufacture. The proposed use of the instrument is an additional and a different one. The gas is taken as we find it, and the object is to see that it is used to the best advantage with such burners as are in common use.

With the ordinary form of the photometer the middle of the bar represents unity—one candle—or an equality of lights. For efficiency purposes the same point represents zero—equality—or no difference in the strength of the lights. One scale indicates the strength of the stronger light in terms of the weaker; the other, the per centum of excess in strength of the larger light over the smaller. Both scales can be graduated on the bar and the same instrument used for both purposes—in fact the divisions are the same for both scales—the numbering only being different.

Two meters are employed, one for each light; they are connected with pipes and a specially designed valve in such a way that both can be started and stopped at exactly the same time without disturbing either light. The pillars for the lights are connected with the meters by means of flexible tubing, and are so arranged that the lights can be raised or lowered vertically. When candles are used for a standard they are placed in a socket attached to the top of one of the burner pillars. With these few exceptions, the instrument is precisely like an ordinary bar photometer. For ordinary use a distance of two meters between the lights answers a very good purpose.

To one who desires to make his own photometer, the graduating of an accurate scale upon the bar might appear to be a difficult matter. This difficulty disappears when we remember that the 4-candle mark will be exactly one-third the distance from the middle of the bar to the center line of either light; the 9-candle mark one-half the distance; the 16-candle mark three-fifths; the 25-candle mark two-thirds, and the 49-candle mark three-fourths of the same distance.

These points being marked on the bar beforehand, the scale can be drawn on paper and the usual tracing and blue prints made. By taking care that the above-noted division marks coincide exactly with the corresponding marks on the bar, the blue print can be pasted to the bar quite as accurately as if the scale were engraved on the bar itself.

The following table has been computed for a bar two meters long, and up to 50-candle. The measurements are taken from the middle of the bar and are given in millimeters. In using the table it must be remembered that the 1-candle mark indicates no difference in the strength of the lights; 2-candle equals 100 per cent. more light; 3-candle 200 per cent. more, etc.

Candles.	Per Cent. More Light.	Distance from Middle in Millimeters.	Candles.	Per Cent. More Light.	Distance from Middle in Millimeters.	Candles.	Per Cent. More Light.	Distance from Middle in Millimeters.
1	0	0	3	240	297	14	1,300	578
	2	5		250	304		1,350	584
	4	10		260	310	15	1,400	590
	6	15		270	316		1,450	595
	8	20		280	322	16	1,500	600
	10	25		290	328		1,550	605
	12	29	4	300	334	17	1,600	610
	14	33		310	339		1,650	615
	16	37		320	344	18	1,700	619
	18	41		330	349		1,750	623
	20	45		340	354	19	1,800	627
	25	55		350	359		1,850	631
	30	65		360	364	20	1,900	635
	35	75		370	369		1,950	639
	40	84		380	374	21	2,000	643
	45	93		390	378		2,050	646
	50	101	5	400	382	22	2,100	649
	55	109		420	390		2,150	652
	60	117		440	398	23	2,200	655
	65	125		460	406		2,250	658
	70	132		480	413	24	2,300	661
	75	139	6	500	420		2,350	664
	80	146		520	427	25	2,400	667
	85	153		540	434		2,450	670
	90	159		560	440	26	....	673
	95	165		580	446	27	....	678
2	100	171	7	600	452	28	....	683
	105	177		620	457	29	....	687
	110	183		640	462	30	....	691
	115	189		660	467	31	....	695
	120	195		680	472	32	....	699
	125	200	8	700	477	33	....	703
	130	205		725	483	34	....	707
	135	210		750	489	35	....	711
	140	215		775	495	36	....	715
	145	220	9	800	500	37	....	718
	150	225		825	505	38	....	721
	155	230		850	510	39	....	724
	160	235		875	515	40	....	727
	165	240	10	900	520	41	....	730
	170	244		925	525	42	....	733
	175	248		950	529	43	....	736
	180	252		975	533	44	....	739
	185	256	11	1,000	537	45	....	742
	190	260		1,050	545	46	....	744
	195	264	12	1,100	552	47	....	746
3	200	268		1,150	559	48	....	748
	210	276	13	1,200	564	49	....	750
	220	283		1,250	572	50	....	752
	230	290						

The table was calculated by the following formula; those who desire to compute a scale for themselves will find it convenient:

Let B = the length of the bar between lights, x = the distance of the candle from the disc, and n = the number of candles for that point: n times x^2 is supposed to be equal to the square of the rest of the bar; or,

$$n x^2 = (B-x)^2.$$

Extracting square root $x \sqrt{n} = B - x$,

$$x(\sqrt{n} + 1) = B,$$

$$x = \frac{B}{\sqrt{n} + 1}.$$

In other words, the distance between the lights divided by one, plus the square root of the number of candles, will give the distance from the candle to the point representing that number of candles.

Many years ago some writer on gas, by a very tedious process, worked out a very clumsy expression for the above, and later writers have all accepted it as the correct thing. The above will not be found in the books. It is correct, however, and is probably the simplest possible formula for calculating a photometer bar, and is, moreover, original with the Western Gas Association. The photometer once completed, there is hardly a limit to the instruction and profit to be gained by its use. The meters indicate the gas consumed, and the bar the light given by each burner; a short double computation will give the value of either light in terms of the other.

In order, however, to reduce the work to a minimum and do away with any calculating whatever, an extensive table has been constructed, which solves the arithmetical part of the problems by simple inspection. For instance, suppose the instrument shows one light, at 5.2 feet per hour, to give 10 per cent. more light than another one at 6 feet per hour. A simple inspection of the table will show that the efficiency of the former is 27 per cent. better than that of the latter. The experiments are so easily and quickly performed that they never become tiresome or tedious, and practice with the instrument becomes so fascinating that the appearance of the whilom archfiend of a gas office—the kicking consumer—is hailed with delight, as affording fresh material for instructive and interesting investigation; while the operator, in his supreme satisfaction, will regard his photometer as "a thing of beauty" and "a joy forever."

DISCUSSION.

The President—Gentlemen, the paper is before you for discussion.

Mr. Bredel—I understand Mr. Chollar has had some experience about the right way of fixing the candles, by weight or by height of flame. I wish he would give us his experience.

Mr. Chollar—I worked for many years with a photometer by weighing the candles, and got very unsatisfactory results, for the reasons shown in this paper. The experiments there show that the light corresponds in no way with the quantity of gas consumed. With a candle we have the changing condition of the wick turning over and around and in all shapes. It is almost impossible, with a gas burner burning at standard rate and with a steady light, to get two successive readings alike, and it shows plainly that a candle used in this way is not correct. A number of years ago some German or French institution spent a great deal of time on the matter, and the result is that in Germany and France, when candles are used, the practice is to use the candle at a standard height of flame. If you use the candle in that way there is no need of the balance of the photometer at all—you have no use for it. The English candles will burn exactly 2 grains a minute when the flame is between 46 and 47 millimeters. Forty-six millimeters is $1\frac{13}{16}$ inches. You have a pair of dividers and you set your dividers at $1\frac{13}{16}$ inches apart, and before you take the reading on the box you measure the height of the flame from the bottom of it to the top. If it is not $1\frac{13}{16}$ inches do not take any reading. If it is too high clip the wick, and if it is too low let it go up. You always have a nice, clean flame, and then by putting a rheometer under the standard burner it will make the consumption of the standard burner always alike, so that you can go through the whole experiment and the reading of the sight-box will be the same all through. In fact, one reading is just as good as a dozen. It simplifies the operation of the photometer. The principal use of this photometer is for comparing the efficiency of burners in practice.

MR. SOMERVILLE—In measuring the flame, what do you do to keep the draught from it?

MR. CHOLLAR—Don't have any draught. If there is any draught there you cannot measure the flame. You must have everything quiet; you must not breathe upon the flame.

MR. SOMERVILLE—I thought perhaps you took some special precautions.

MR. CHOLLAR—You can take any you please. I am careful not to breathe upon the flame. When I take the height of a flame I put a pair of smoked glasses on, so that it will not affect my eyes for reading the sight-box.

MR. SOMERVILLE—I have often noticed in the photometer room the flame will move a little in spite of you.

MR. CHOLLAR—You must not take a reading except the flame is at that height, and you will always have the same reading through the experiment. That is only a secondary use of this photometer, but the main use of it is for the efficiency of burners. I can show some remarkable work done with it.

MR. HIGHLANDS—This is a very practical paper, and it opens up another question, regardless of the photometer, which is as to the comparative merit or demerits of the ordinary jet which we are compelled to use in burning different quantities of gas. The question arises to me in this way, by what method are we going to control the consumption of gas in those burners? What is the easiest and simplest method for giving each of those burners the necessary amount of gas?

MR. CHOLLAR—In my own opinion the best way would be to make a department for that special business; for gas consumers will not attend to it.

MR. SOMERVILLE—I have been much struck with the point that Mr. Highlands has brought out here, and which Mr. Chollar so clearly demonstrates, the necessity of education to the gas consumer, who will not come and be educated himself; for that is a fact. Many years ago I suppose some few here will remember that I had the honor of reading a paper, before the American Gas Light Association, on the subject of "The Defects of the Gas Globe and Holder." I then took the stand that Mr. Chollar is taking to-day, that the gas companies ought by all means to control the gas at the burners; that it is their business to do so. I showed or tried to show them the amount of light that was wasted, as Mr. Chollar has done to-day, and as our customers are doing all over our districts. The objection I remember then was the gas companies *could not* take the responsibility. Such was the objection urged against the paper—that the gas companies should not because they could not take the responsibility of controlling or having anything to do with the gas fittings. I often thought since then, and think so now, that we owe a debt of gratitude to the electric light companies, in that they have shown the gas companies how to do business in this respect. They are not afraid of taking any responsibility. Just suppose for a moment, if we can suppose such a thing, of an electric light company trying to do business on the line that a great many of us are doing. We will suppose that an electric light company has started in, has its machinery and dynamos all up and the office open. A man comes to the office and says he wants the electric light. "Well," says the gentlemen at the desk, "Is your house wired?" The man answers, "No." "Oh, then," remarks the electrician, "you must get your house fitted, and as soon as you get that done we will turn on the electric light." "Well," utters the man, "will you do it for me; I don't know anything about it," and in reply thereto is told, "No, get a fitter to do that; that is not our business, sir; our business is to supply electricity; you have to find a fitter and when the house is completed you come and speak to us and we will see about putting in the electric light." Just suppose for a moment that that was the case; how would electric companies have succeeded—as they are doing to-day? We must, as Mr. Chollar says, educate the people how to burn our gas. Nothing is more annoying to us than to see our 20-candle gas brought down to 6 or 7-candles, by our consumers using dirty, unsuitable burners, as has been so fully shown by his experiments here to-day. For some time past the Company I represent has employed a man whose sole duty is to go from store to store, with his pockets full of burners, and a pair of plyers. He takes off all poor burners and replaces them with burners best suited to give the most light from the gas. That man fully earns his wages, both in the increased consumption resulting from his work and the satisfaction he is giving our customers (at this point Mr. Clark lit one of the gas burners in the convention room which gave a very poor light).

MR. CLARK—There you can see the point. (Laughter and applause.)

MR. SOMERVILLE—That is a sufficient demonstration. I wish before sitting down to express my personal gratification for this paper. Mr. Chollar deserves great credit. It is a beautiful instrument, and I think every gas company ought to have one.

MR. CHOLLAR—The experiments with this photometer are not difficult at all. One minute would show just how bad a burner the one in the room here is, in figures.

MR. SOMERVILLE—Undoubtedly.

MR. CHOLLAR—You invite the consumer to come to your office and see for himself. You not only tell him he has got a bad burner, but also you show him just how bad it is, and give him the figures.

MR. JENKINS—What is the efficiency of that light up there?

MR. CHOLLAR—I should judge about two. (Laughter.)

MR. TRACY—One point made by Mr. Somerville I do not think we all could afford to follow, and that is to employ a man to do as is done at Indianapolis. Is it not possible that the consumer might claim that that man was sent around with a view to increasing the Company's gas bills?

MR. W. L. BROWN—I represent a small Company, and, therefore, it is not for me to attempt to teach you; but I will state that for the last four years we have been doing just what Mr. Somerville advises. We have a man who does nothing but attend to the burners. On the least complaint we send him to the houses or stores of the consumers.

MR. MURDOCK—I represent a small Company, whose method is to have little cards printed, which are distributed to every consumer in the city. On the card we stated that the Gas Company had burners and tips at the office, which it would send out and put on at its own cost, on notification by the consumers. The card also stated the amount of gas lost by imperfect burners. I found the practice had a very good effect.

MR. HIGHLANDS—It occurs to me that we have not struck the meat of this question yet. My friend Somerville compares the method of procedure of electric light companies with that of gas companies. I was unfortunately manager of an electric light plant as well as a gas plant. In handling electric lights we have our meters, so that we constantly know the strength of the current that is going out over our lines—at least, we know what efficiency each of our lamps should give us; and, with the exception of incandescent lights, our customer is the constant and immediate judge as to whether his lamp is giving good service or not; but in the case of gas burners my friends may have customers who report when the burners are out of order, but I have never had one. I have found gas tips so adjusted that with a tip capable of passing 12 or 15 feet an hour I was positive of getting only 8 or 9 feet an hour through it. Until we arrive at some such method as that, I do not see how we are going to get the efficiency of the burners.

MR. CHOLLAR—You can get the efficiency when the burners burn the proper amount of gas, a point that has to be taken care of by the gas companies themselves. The consumer never will object at all to your giving him more light for less money; but they will not complain until they get very bad light, and then they will "kick." You take the average burners right through a street and they will develop not much over two-thirds of the light they ought to. It is business that the gas companies will have to care for themselves.

MR. ODIORNE—I would like to ask if Mr. Chollar took the case of check burners.

MR. CHOLLAR—Check burners, or anything else to make the rate right. If the pressure is too high use a check burner; if it is not high enough clean the pipe so that you get plenty of pressure. Check burners as a general rule are the best.

MR. LANSDEN—A great many burners are made nowadays that are not check burners—they are governor burners. It is utterly impossible for any gas company to supply the same pressure at the various points through the district. The only thing to do is to put on governor burners.

MR. CHOLLAR—I have tried a great many governor burners, and found out that, when the tip is suited to the governor and the governor is clean, it is all right; but the check burner, which answers all purposes, only costs 2 cents. Suppose you get 3 inches of pressure in the main; it may vary from 1 inch to 4. Now, a check burner can be put on there and regulate it. Have a proper tip, so that the pressure can go down to 1 or up to 4 without affecting the efficiency to any great extent. It is not necessary to have the rate exactly uniform. A burner suited to burn 6 feet could burn 5 feet or 7 feet, and it would give more light at 7 than at 5; but the main point of efficiency is that a burner which is all right at the present time, in six months from now will not be in good order. The burners ought all to be examined periodically, and tests recorded showing how bad they were. Not only that, but the Company should grease the stopcocks and give them a general overhauling. In keeping them in order the Company will be well paid for the work.

MR. JENKINS—In your No. 2 tip, burning under, I should judge, 1 inch pressure, you say that at 2.3 feet per hour you have an efficiency of 81. The more you increase the pressure the less efficiency you have. Where you are burning 10 feet you are only getting an efficiency of 66. In the 11-foot burner, burning 5 feet, you have an efficiency of 94. We want a burner that will give the same efficiency all the way through.

MR. CHOLLAR—You cannot do that. You can adjust a burner so that with the fluctuating pressure in the mains the efficiency will vary only a little.

MR. JENKINS—If you double your pressure you increase the flow.

MR. CHOLLAR—Four times the pressure will double the flow.

MR. JENKINS—Double the pressure and you increase it 25 per cent.

MR. CHOLLAR—The flow is in proportion to the square root of the pressure. That law does not hold good with burners at low pressure.

MR. JENKINS—If you put a governor on you won't have your variation; you will control the variation in the main.

MR. CHOLLAR—As I understand, your check is simply two little holes. It might be a burner with a screw in it. I have a little instrument that I brought along to show the difficulty of taking the pressure at the tip, but I did not bring it to the hall. In order to get the pressure at the tip you put the pressure guage between the check and the tip. You are using a check burner, for instance, with 4 inches pressure in the main. You will perhaps have only 5-tenths or 6-tenths above the check; at the tip the pressure varies only slightly.

MR. JENKINS—You have a tip that burns more than your check will carry through.

MR. CHOLLAR—I do not have any particular check or tip at all.

MR. JENKINS—Don't you have your tip to burn more than the check would ordinarily carry through?

MR. CHOLLAR—Generally.

MR. JENKINS—Don't you have to do that always; for instance, what good would your check be—say, that your check would pass 6 feet and your tip would only burn 2 feet, what good would your check be?

MR. CHOLLAR—Well, if the check don't "check" it is of no use.

MR. LANSDEN—That question is just what I want to get at. I claim that if a check burner will only give the same amount of gas under the same pressure, it does not check. I put a pressure of 1 inch on a burner with a 6-foot tip. If I put a pressure of 3 inches on that same burner tip I will not get as much light on the photometer as I had with the low pressure, because I increased the pressure between the check and the tip, which ought to be, I think, from 3-tenths to 4-tenths.

standard, had not something better be done about that—some committee appointed; or the Secretary, perhaps, instructed to notify the founders to that effect?

Mr. Ramsdell—I took it for granted that the Society of Gas Lighting would take charge of that work. All of the Associations are adopting the same standards, and it seems to me that one Society or one Association could do that work better than to have each of us do it. I would suggest that the Secretary of this Association make known to the Secretary of the Society of Gas Lighting whatever action we may take to-day.

The President—I think that is sufficient.

On motion of Mr. Ramsdell the plans, as proposed, were adopted by the Association.

The President—The next business we have is the paper by Mr. Fred. Bredel, of Milwaukee, Wis., entitled

THE ADVANTAGES OF RECUPERATIVE FURNACES IN THE UTILIZATION OF HEAT.

To determine the advantages of generating furnaces, more properly recuperative furnaces (such as convert the solid fuel, first, into generator gas, and then burn the same to CO_2 and H_2O, by means of a secondary air supply, previously heated by means of a recuperator), let us consider all the advantages separately:

First.—The saving of fuel.

Second.—The saving in labor.

Third.—The saving in floor space per 1,000 feet of gas made.

Fourth.—The greater production per retort before same needs replacing; or, in other words, the saving in wear and tear.

The disadvantages are: The greater first cost.

I. *Saving of Fuel.*—For the analytical calculation of the saving of fuel, I will have to use the metric system throughout, but will give at all times the total result in pounds, cubic feet and British heat units.

To determine the amount of fuel saved for a certain amount of gas made, let us first understand the process under which the fuel is consumed by both ways of heating retorts. In the ordinary way of free fire the solid carbon contained in the coke is burned immediately to CO_2, and forms thereby 1 weight unit carbon, 3.66627 weight units CO_2. In generating firing, the carbon is first burned to CO_2, then, by passing through a layer of hot coke, it is reduced to CO, and then burned to CO_2, by a secondary air supply previously heated, and forms the same amount, or 3.66627 weight units CO_2, and gives the same amount of heat as it would give if it were burned directly to CO_2. In the calculation I have taken the exact atom weights, being 11.97 for carbon and 15.96 for O. In the free fire furnace the process is: one kg. of carbon burned to 3.66627 kg. CO_2 develops 8,080 calories. In the generator firing the process is as follows:

	Calories.
½ kg. C is burned to 1.833135 kg. CO_2, giving	4,040
This CO_2, by passing through a layer of hot coke, is reduced to 2.333135 kg. CO, by taking up ½ kg. C.	
To make this reduction 2,846.5 cal. are absorbed. We have, therefore, to subtract this amount absorbed	2,846.5
Therefore, heat left	1,193.5
Add to this the heat formed by ½ kg. C to CO	1,193.5
To this add the heat formed by burning 2.333135 kg. CO to CO_2, equal to 2,440 cal. per kg., or	5,693
Or total heat developed	8,080

Or, expressed in British measurement, 1 pound carbon gives in either case 3.66627 pounds CO_2 and develops 14,544 British heat units. This shows that the heat produced is the same if C is burned direct to CO_2, or first to CO_2, then reduced to CO, and burned again to CO_2.

With free fire furnaces the combustion is generally very imperfect, and quite an amount of heat is lost by sending CO to the chimney; furthermore, a great deal of water is evaporated and sent as hot steam into the chimney—another loss.

The waste gases of a free fire bench leave the bench generally at a temperature of 1,000° C., or about 1,850° F., while with a good recuperative furnace the temperature of the waste gases ought not to be higher than 350 to 360° C., or about 650 to 680° F. (See paper read by me before Ohio Association.)

Let us now figure out the amount of heat lost by burning the coke on an ordinary grate. To do this we must first know the composition of the waste gases. Assuming, as is generally done, the furnaces are fired every hour, the average composition of the waste gases of a well worked bench will be as follows:

CO	1 per cent.
CO_2	11 "
O	8 "
N	80 "
Total	100 per cent.

One kg. carbon forms 1.8533 cubic meters CO or CO_2, and we have:

1 per cent. CO $= 1 \times 1.8533 \div 12 =$ 0.1544 cubic meters CO.
11 per cent. $CO_2 = 11 \times 1.8533 \div 12 =$ 1.6989 cubic meters CO_2.
8 per cent. O $= 8 \times 1.8533 \div 12 =$ 1.2355 cubic meters O.
80 per cent. N $= 80 \times 1.8533 \div 12 =$ 12.3553 cubic meters N.

Or, expressed in weight:

CO 0.1544 × 1.2555 (spec. w.) = 0.1938 kg. CO.
CO_2 1.6989 × 1.9781 " " = 3.3606 kg. CO_2.
O 1.2355 × 1.4304 " " = 1.7673 kg. O.
N 12.3553 × 1.2567 " " = 15.5269 kg. N.

To find the heat carried away we have to multiply above weights by the specific heat of the gases, and the difference between the temperatures at which the gases leave the furnace and the air enters the grate, or 1,000° — 20° = 980° C. To this we have to add the heat carried away by about 0.250 kg. steam, this being about the amount of water evaporated in the ash-pan, and also to add the amount of heat lost by incomplete combustion. The cooling off of retorts by opening the fire door we will consider later.

	Kg.	Specific Heat from 0 to 1,000° C.	Temperature 1,000 —20° C.	Calories.
CO..............	0.1938	× 0.2450	× 980 =	46.54
CO_2..............	3.3606	× 0.2940	× 980 =	968.25
O..............	1.7673	× 0.2175	× 980 =	376.69
N..............	15.5269	× 0.2438	× 980 =	3,709.75
H_2O..............	0.2500	× 0.6790	× 980 =	166.36
Total............	21.0986			

Heat carried away..........................	5,267.59
Loss of 0.1938 kg. CO is 472.87 — 249.57......	223.30
	5,490.89
The loss by opening the fire door can be safely figured at 5 per cent., but in the general run it is much more. 5 per cent. of the above 5490.89 cal. added..............................	263.34
Total loss..............................	5,754.23
Or round..............................	5,750
The total heat developed was.................	8,080
or a loss of 71.2 per cent.	

Loss of Heat in Recuperative Furnaces.—By an average of 10 analyses I found the waste gases to contain as follows:

CO_2..............................	17.92 per cent.
CO..............................	0.08 per cent.
O..............................	2.17 per cent.
N..............................	79.83 per cent.
	100.00

The average temperature of waste gases before entering the chimney flues was 360° C. The amount of waste gases formed by one kg. carbon was as follows:

17.92 per cent. CO_2: $17.92 \times 1.8533 \div 18 = 1.8451$ cubic meters.
0.08 " " CO: $0.08 \times 1.8533 \div 18 = 0.0082$ " "
2.17 " " O: $2.17 \times 1.8533 \div 18 = 0.2234$ " "
79.83 " " N: $79.83 \times 1.8533 \div 18 = 8.2194$ " "

Or, by weight:

CO_2 1.8451 cubic meters: $\times 1.9781 = 3.6498$ kg. CO_2.
CO 0.0082 " " : $\times 1.2555 = 0.0103$ kg. CO.
O 0.2234 " " : $\times 1.4304 = 0.3196$ kg. O.
N 8.2194 " " : $\times 1.2567 = 10.3293$ kg. N.

To find the heat carried away we have to multiply specific heat of gases at 360° by difference in temperature (360 — 20), 340°, and add the heat carried away by steam formed from 2 H and O. The amount of water used under grate is 30 per cent., or 0.3 kg. per kg. of carbon, and we have as follows: (See paper read by me before the Ohio Association.)

	Kg.	Spec. Heat at 360° C.	Difference in Temp.	Calories.
CO_2 equals.........	3.6498 ×	0.2340 ×	340 =	290.38
CO equals.........	0.0103 ×	0.2450 ×	340 =	0.86
O equals...........	0.3196 ×	0.2175 ×	340 =	23.63
N equals..........	10.3293 ×	0.2438 ×	340 =	856.21
H_2O equals........	0.3000 ×	0.525 ×	340 =	5.36
	14.6090			1,176.44
Plus loss on 0.0103 kg. unconsumed CO......				12.13
				1,188.57
Plus loss of heat by opening filling door, less 5 per cent...............................				51.43
Total loss.........................				1,240.00
The heat gained by firing hot coke, coke being used direct from retorts at about 750° C., or about 1,400° F., specific heat of coke being 0.2031				150.00
The total loss, therefore..................... or 13.5 per cent.				1,090.00

Or, expressed in British measurement, the total heat lost by waste gases is for: Free fire benches, 10,350 British heat units, or 71.2 per cent.; recuperative benches, 1,962 British heat units, or 13.5 per cent. This would be the correct percentage of loss providing all the heat was directly used to heat retorts, but with the recuperative furnaces part is used to superheat the primary and secondary air supply; and there is at all times a loss by radiation and leakage, etc., amounting to about 500 cal., and the actual loss is, therefore, about 20 per cent. for recuperative furnaces.

We will now make a calculation of the flame temperature and of the absolute pyrometric efficiency of the different furnaces. The flame temperature for the recuperative furnace will appear high, but it must be remembered that this temperature is obtained only at a certain point and distance above the point of the uniting of CO and O, and will be immediately absorbed and lowered beyond that point.

The Pyrometric Efficiency and Flame Temperature.—To find the flame temperature of combustion, divide the total heat developed by the amount of waste gases multiplied by specific heat. We have therefore:

First, for free fire furnaces—

$$\frac{8{,}080 - 223}{0.1938 \times 0.245 + 3.3606 \times 0.3305 + 1.7673 \times 0.2175 + 15.5269 \times 0.2438 + 0.25 \times 0.7735}$$

equals

$$\frac{7{,}857}{0.04748 + 1.11068 + 0.38439 + 3.78546 + 0.19337}$$

equals

$$\frac{7{,}857}{5.52138} = 1{,}422^\circ\text{ C.} = 2{,}690^\circ\text{ F.}$$

Second, for recuperative furnaces—

The total amount of heat developed by 1 kg. carbon burned to CO_2		8,080 cal.
Minus loss by opening fire door	52	
Minus loss for unconsumed CO	12	— 64 "
		8,016 cal.
Plus heat gained by firing hot coke		150 "
Plus heat absorbed by primary and secondary air in recuperator and returned to combustion		2,268 "
Total		10,434 "

And we have:

$$\frac{10.434}{3.6498 \times 0.398 + 0.0103 \times 0.245 + 0.3196 \times 0.2175 + 10.3293 \times 0.2438 + 0.3 \times 0.9545}$$

equals

$$\frac{10.434}{1.45262 + 0.00252 + 0.06951 + 2.51828 + 0.28635}$$

equals

$$\frac{10.434}{4.32928} = 2.410^\circ\text{ C.} = 4.370^\circ\text{ F.}$$

If primary and secondary air, were not superheated we would have, al amount of heat developed 8,166 cal., and 14.6090 kg. products combustion, and average specific heat of 0.28749 and flame temature; therefore,

$$\frac{8,166}{14.609 \times 0.28749} = 1,950^\circ \text{ C.} = 3,540^\circ \text{ F.}$$

The total amount of heat developed by 1 kg. carbon is as follows: ee fire benches, 7,857 cal.; generative benches, 8,166 cal.; reperative benches, 10,434 cal.

To find out the heat utilized to heat the retorts we have to figure out e amount of heat the gases contain when their temperature drops to 000° C.

This is for free fire benches, as shown before, 5,531 cal.

For recuperative and generative benches in both cases, 14.609 × .28749 × 980 = 4,115 cal. And we have:

	Open Grate.	Generative Furnace.	Recuperative Furnace.
Total heat at disposition	7,857 cal.	8,166 cal.	10,434 cal.
Heat carried by gases at 1,000..	5,531 "	4,115 "	4,115 "
Heat available for heating retorts	2,326 cal.	4,651 cal.	6,319 cal.
Total amount heat in 1 kg. carbon	8,080 "	8,080 "	8,080 "
Or an efficiency of............	28.78 p. c.	50.13 p. c.	78.20 p.c.

Or, putting the consumption of coke of a recuperative bench at 100 pounds, the benches would use as follows: Recuperative bench, 100 pounds; generative bench, 156 pounds; free fire bench, 272 pounds.

The foregoing calculation shows plainly the great advantage gained by thoroughly superheating the primary and secondary air supply (principally the latter.) I have a table prepared showing the amount of heat transmitted per 10 square feet of fire brick wall, providing the air has a good access to the heated surfaces and takes the heat as fast as it is transmitted.

This diagram exhibited shows the nearly absolute necessity of having thin division walls between waste gases and air, and a large heating surface. Furthermore, it is best to change the direction of air very frequently, as is done, for instance, in the Klœnne recuperator; otherwise the heat by radiation will be the only heat completely utilized, while the heat by contact will be utilized only to a small extent.

The amount of heat lost by radiation for a bench of 9 retorts, working 10 or more benches in a stack, is per hour, 31,000 cal., equal to about 123,000 British heat units.

The amount of heat lost by two benches of 6's, free fire, is 32,500 cal., equal to about 129,000 British heat units.

The production of gas per 24 hours is the same:

9 retorts at 10,000 feet = 90,000 feet per diem.
12 retorts at 7,500 feet = 90,000 feet per diem.

So we find that the loss by radiation does not differ much in either case.

By actual experiments I have found that 100 pounds of Youghiogheny coal, distilled in benches of 9's, use 10.5 pounds of hot coke and make a little over 5 feet of gas; or 90,000 feet require 18,000 pounds of coal, and this requires 1,890 pounds of coke, providing the benches are worked right. This 1,890 pounds of coke contain, on an average, 1,757 pounds of carbon. Of this amount about 57 pounds are thrown away with the clinkers, and we have left 1,700 pounds of carbon.

As we have seen in recuperative furnaces, the total heat utilized is 78.23 per cent. of the theoretical 14,544 heat units, or 11,378 heat units, or 1,700 pounds of carbon

develop........193,423,000 heat units. Of this are
lost by radiation 3,352,000 heat units.

190,071,000 heat units used to distill 18,000 pounds coal and heat the resulting gas and coke.

If we should use all the heat contained in the coke we would only have to use:

190,071,000 divided by 14,544, equals 1,307 pounds carbon.
Minus 57 pounds carbon wasted in ashes and clinkers.............. 57 pounds carbon.

Or.......................... 1,250 pounds carbon.
Or coke containing 93 per cent. carbon 1,344 pounds coke.

The ideal bench, where there is no loss by radiation or of carbon in ashes nor by waste heat, is the bench that could distill 100 pounds coal by 1,344 divided by 18 equals 7.47 pounds coke.

	Pounds.
In the best recuperative benches to date are used....	10.5
In the generating benches without recuperation the consumption amounts to 10.5 × 1.56............	16.38
In free fire benches the consumption is 10.5 × 2.72..	28.56

Or the net efficiency for different ways of firing expressed in per cent.:

Recuperative........................	71.14 per cent.
Generating..........................	45.60 "
Free fire...........................	26.15 "

The foregoing clearly shows that what is wanted is high flame temperature. If we compare CO and H, we find:

1 weight unit CO requires 2.4645 weight units air and forms.....1.5714 weight units CO_2.
Plus.......................1.8931 " N.

Specific heat CO_2 at 2,200° C., or 4,000° F., is 0.395. Therefore,

$$\begin{aligned} 1.5714 \times 0.395 &= 0.6207 \\ 1.8931 \times 0.244 &= \underline{0.4619} \end{aligned}$$

1.0826 specific heat per weight unit;

And as 1 kg. CO develops 2,440 cal. flame

temperature $= \frac{2,440}{1.0826} = \ldots\ldots\ldots\ldots$ 2,250° C.

And as 1 lb. CO develops 4,392 heat units

flame temperature $= \frac{4,392}{1.0826} = \ldots\ldots\ldots$ 4,058° F.

1 weight unit H requires 34,417 weight units air, and forms.................. 8.98 W.U.H.

Plus..................................26.4371 W.U.N.

Specific heat of H_2O at 1,900° C., or 3,500° F., is 0.885; therefore,

$$\begin{aligned} 8.98 \times 0.885 &= 7.9473 \\ 26.4371 \times 0.244 &= \underline{6.4506} \\ & 14.3979 \end{aligned}$$

And as 1 kg, H. burned to H_2O (vapor) develops 29,141 cal.

flame temperature $= \frac{29,141}{14.3979} = \ldots\ldots\ldots\ldots\ldots\ldots$ 2,025° C.

Or as 1 lb. H burned to H_2O (vapor) develops 52,454 heat

units flame temperature $= \frac{52,454}{14.3979} = \ldots\ldots\ldots\ldots\ldots$ 3,640° F.

Therefore we must see to it that the generator gases contain as much CO as possible and as little H as possible.

II. *The Saving in Labor.*—Exact figures on this subject cannot be given, as the amount of gas made per man per 12 hours is vastly different; but it should be about 35,000 to 40,000 feet with recuperative benches, against 25,000 to 30,000 feet with ordinary benches. But at different works and under different conditions this may vary somewhat.

III. *The Saving in Floor Space.*—A stack of 12 benches of 9's, having a capacity of 1,080,000 feet, or round one million, occupy a floor space 63 × 78 feet = 4,914 sq. feet. = 4.914 sq. feet per 1,000 feet of gas per 24 hours. Twenty-four benches of 6's, with ordinary free fire grate, have the same capacity and require 115 × 63 = 7,245 = 7.245 sq. feet per 1,000 feet gas.

IV. *The Saving in Wear and Tear.*—The cost of repairing and resetting a bench of 9's recuperative system, or bench of 6's free fire, is about the same per retort; but the retort in the bench of 9's will, on account of even heat and absence of slack, etc., last much longer (or, more exactly speaking, make more gas) than a retort in a free fire bench. By practice I have found out that a good retort in recuperative benches makes on an average from 7 to 9 million feet before replacing becomes necessary, while in a free fire bench a retort averages generally from 4½ to 6 million feet.

Disadvantages —The Greater First Cost.—To consider the first cost of the different benches, we must supply both benches with the same quality of iron work, such as self-sealing mouthpieces, large mains, etc., and figure the cost per 1,000 feet of gas made per 24 hours, and not per bench.

It will require two benches of 6's to do the same work as one bench of 9's, and we find the cost to be about as 10 is to 9 in favor of free fire benches; but as the difference is so small (only about $5 per 1,000 feet capacity) it is hardly worth while to consider it, although benches might, without self-sealing mouthpieces and in sluggish workmanship, be built cheaper and make the difference about 10 to 8, or up to $9 per 1,000 feet. But it at all times pays in the end to pay a higher price for good benches and good workmanship.

To sum up, on a production of 100,000 feet per 24 hours the saving in fuel in recuperative benches over generative benches is 1,176 lbs coke, at $3.75 per ton, $2.21; over free fire (open grate) benches is 3,612 lbs. coke, at $3.75 per ton, $6.77. The saving in labor, about 25 per cent., or about $2.50. The saving in wear and tear, 25 cents to 35 cents.

The disadvantages: The greater first cost, at 10 per cent. on first cost, from $\frac{5,000}{365}$ to $\frac{9,000}{365}$, or say that all the benches would work only 200 days per year, $\frac{5,000}{200}$ to $\frac{9,000}{200} = 25$ to 45 cents per 100,000 feet per 24 hours. Or, expressed per 1,000 feet in cents, recuperative against free fire—

	Gross Gain.	Gross Loss.	Net Gain.
Coke	6.77		
Labor	2.50		
Wear and tear	0.30		
Greater first cost		0.35	
	9.57	0.35	9.22

Plus saving in floor space of 2,331 square feet.

DISCUSSION.

The President—Gentlemen, this paper is before you for discussion, and we will be glad to hear from any one.

Mr. Egner—I think that very few who have never done this kind of work which Mr. Bredel has gone into so fully, in preparing a paper like this is, can appreciate the amount of labor that it calls for. I think that it is one of the best papers we have ever had before this Association. I have read it over, but I did not see it soon enough to verify any of the figures. I got it just before starting for Detroit, and I am very much pleased with it.

MR. JAS. W. DUNBAR—Mr. Bredel starts out with the statement that recuperative and generative furnaces are the same thing. Then, he gives the best recuperative benches to date as using 10.5 pounds of coke per 100 pounds of coal, and in the generating benches, without recuperation, at 16.38 pounds of coke. I would like him to define more clearly what constitutes a generating bench.

MR. BREDEL—A generating bench I consider a bench where the coke is gasified and afterward burned by the secondary air supply.

MR. DUNBAR—Then you make the distinction as one in which the primary air supply is heated in the recuperative but not in the generative.

MR. BREDEL—A recuperative bench is a generative bench, but a generative bench is not every time a recuperative bench.

MR. DUNBAR—In the generating bench you heat your secondary air supply?

MR. BREDEL—No, sir; not in the generating bench.

MR. DUNBAR—I cannot agree with Mr. Bredel in his conclusions in regard to the superiority of recuperative benches over what he terms the ordinary benches; and I term a generating bench, or half-depth generative bench, in which the secondary air supply is heated, as being under the classification of an ordinary bench. It is in all respects an ordinary bench, in that the only difference in construction is that you build your furnace deeper, and perhaps a little wider and longer, and at a very little additional cost you can put in your secondary air flues, so that in the bench you have one in all respects that is an ordinary bench. With this kind of a bench you can get results approximately as high as Mr. Bredel claims with recuperative benches. It is a bench that in all respects is an excellent one—one that is economical; and the only superiority that I can see in recuperative benches is that the consumption of coke is very much less, and in that respect there is a saving; but a saving in floor space and labor there is not. If we can obtain as much from a retort with a generative bench, then the floor space he has calculated for 24 benches of 6's would be the floor space required for 18 benches, which would reduce the floor space to about that occupied by recuperative benches producing the same amount of gas. Now, about the saving in wear and tear. He says the cost of repairing and resetting a bench of 9's, recuperative system, or bench of 6's, free fire, is about the same per retort. I claim we cannot build a recuperative bench for the same price, or about the same price, that we can a bench with the ordinary fire grate system. In the recuperative bench the complications in the settings of the flues are great and many, and you cannot take out a bench without rebuilding these flues, because the leakage from them would be such as to totally depreciate the efficiency of the bench. A man would not be justified in resetting the retorts without rebuilding his flues. Then he speaks of the greater first cost. He has the greater first cost only 10 per cent. more than the open free fire; but the difference is certainly 100 per cent. It compares just about the same as a two-story house to a one-story house. In the first place, the height is twice as great, and the foundations are greater; so that the statement that a bench of recuperative furnaces costs only 10 per cent. more I do not think is correct. I do not think any builder of benches would agree to build a bench at a cost or increase of only 10 per cent. He has figured up at the end a saving of 9.22 cents per 1,000 feet of gas made in the recuperative bench, over generative benches. He can claim no saving except for coke. He has a saving for coke figured out at 2.21 cents per 1,000, but at the figures he gave before it was only 1.88 cents. He takes the coke there at 1,176 pounds, but in the table given in another place it would only amount to 1,024 pounds, which would reduce that to 1.88 cents. Now, the greater first cost of 0.35 per 1,000 certainly will not be borne out. I do not think any manufacturer of benches would agree to put in a recuperative bench at only 10 per cent. more cost. If in generative benches of 6's the same yield per retort can be obtained, of course his saving in labor of 2.5 cents per 1,000 will not hold good. Then, another thing: in building your retort house you have to build it twice as high, and the increase in expense there is very great.

MR. HUMPHREYS—We all have to speak in the same language, or we cannot have an intelligent discussion. I would like to have the gentleman who last spoke define what he means by a generative bench.

MR. DUNBAR—What I would term a half-depth generative bench is one in which you have a large furnace, and one in which you utilize a secondary air supply to burn off the remaining carbonic oxide in the gas.

MR. HUMPHREYS—Is that what you term a generative bench?

MR. DUNBAR—I would term it a half-depth generative bench.

MR. HUMPHREYS—I would like to ask the gentleman if he would not term that a recuperative bench, though of perhaps a somewhat different construction.

MR. DUNBAR—I make this statement, that that kind of a bench is an ordinary bench, and it can be built at a very little increased first cost; and I mean to be correct in my statement that it is a half-depth generative bench. I deem it an ordinary bench and a good bench.

MR. HUMPHREYS—He would simply state that in the same way, if all the benches in this country were recuperative benches full depth, they would be ordinary also.

Mr. Dunbar—Mr. Bredel makes a comparison between what he claims to be a recuperative bench and an ordinary bench. I took his idea of what constituted an ordinary bench.

The President—Mr. Bredel made the comparison between a recuperative bench and a free fire bench, but not a comparison with generative benches.

Mr. Geo. Treadway Thompson—I think Mr. Dunbar misunderstands with reference to the difference between half-depth and full-depth recuperative furnaces. As Mr. Bredel has stated, a recuperative bench is a generative bench, but all generative benches are not recuperative. I take it that Mr. Bredel's understanding of a generative bench would be one in which the secondary air was not superheated, or one with the open hearth system, such as the Siemens system, as used in some of the Scotch works. Am I right, Mr. Bredel?

Mr. Bredel—You are. About the cost, I think I am right. I think I know what I am talking about; and, of course, I would back it up. The cost is per 1,000 feet of gas made, and not per retort or per bench. What difference does it make how many benches are required, if they do the same amount of work—whether 1 of one kind or 10 of another kind? You are not going in to buy, for instance, an engine at so much per volume—an uncertain quantity; you want to know exactly how much work can be done with it, and that is the point I make. I have written this paper from actual experience, and I think I am right.

Mr. Dunbar—I have no doubt but that the gentleman is right, and he has, indeed, written a very valuable paper; but what I object to is his comparing of results capable of being obtained in the recuperative and ordinary benches. The point I am driving at is this: I built a furnace—I do not know exactly what kind of a furnace it is, but I know it has a secondary air supply; it is a bench of 6's; and I get the same results per retort out of these benches of 6's that Mr. Bredel claims he can get out of a bench of 9's, recuperative settings. It does not take any more floor space worth considering to produce the same amount of gas, requires no more labor, and the greater first cost per retort will not begin to amount to the cost of recuperative benches based on an equal production per retort.

Mr. Bredel—You are absolutely wrong there. A bench of 9's occupies a floor space of 12 feet from center to center, and a bench of 6's occupies a floor space of 9 feet 6 inches, and the capacity would be, in comparison, much more per square foot.

Mr. Dunbar—He has the number of square feet for a bench of 9's sufficient to produce 1,080,000 cubic feet of gas at 49,014. With benches of 6's you get the same result per retort. Seven thousand two hundred and forty-five square feet would be reduced one-quarter, which would bring it down to 5,434—very little more than required for the setting of 9's. In his calculation of floor space required for benches of 9's to produce 1,080,000 cubic feet, and benches of 6's to produce the same amount of gas, the difference is about 2,300 square feet, whereas the difference would be only about 500 square feet.

MR. BREDEL—You are talking all the time about generating benches, and I am talking about free fire benches and recuperative. So there is no use of your talking about generative benches, for we are not talking about the same objects.

THE PRESIDENT—Mr. Dunbar, Mr. Bredel is making his comparison between recuperative furnaces and free fire benches. He confines his comparison to that, and he claims that two benches of 6's are equal to one bench of 9's—two benches of 6's with an ordinary free fire are equal to one bench of 9's, recuperative bench.

MR. THOMPSON—Perhaps Mr. Dunbar would be satisfied if Mr. Bredel will acknowledge or state that he does assume the half-depth regenerative bench, which Mr. Dunbar has, to be a recuperative bench.

MR. BREDEL—That is what I say—that is what I have been driving at all the time.

THE PRESIDENT—We would be glad to hear from some other gentleman. The paper perhaps does not admit of such a discussion as some of the others we have had, but possibly some other gentleman may want to say something.

MR. CHOLLAR—It seems there is not so much difference between Mr. Dunbar and Mr. Bredel, as Mr. Dunbar would think, because they are both talking about the same kind of a furnace but of different construction. Mr. Bredel has one kind of recuperative furnace in his mind while Mr. Dunbar has another, and Mr. Dunbar only supports what Mr. Bredel has said. One point in that paper pleases me very much. I have worked at it a good deal and Mr. Bredel has solved it in a very nice way. We have been wanting some means of finding out the theoretical quantity of fuel necessary to volatilize coal in the retort, and it seems the simple way always comes at last. In the latter part of Mr. Bredel's paper he has figured it out very nicely and in a very simple way.

On motion of Mr. Jenkins, a vote of thanks was tendered to Mr. Bredel.

QUESTION BOX.

THE PRESIDENT—We have several questions here which we would like answered. One is:

"*Does it pay to dispense with stopcocks and boxes on service pipes?*"

MR. LANSDEN—At one time I had charge of three or four small works in growing western towns. The practice of the authorities was to put down plank pavements, and there were no thoroughly established street grades. I had charge of one works for about two years in a town the buildings in which were mostly frame. One night a fire that started burned up about 20 buildings before the fire was extinguished. Our stop-boxes had been put in the wooden pavements, and I undertook, with the men, to turn them off but only succeeded in turning one off out of 20. I found I could get quicker and better results by leaving the gas burning as the fire progressed and remove the meter. After that I built several small works in similar towns, and never put in any stop-boxes. However, in cities where the pavements and the grades are all right, and where you can keep the top of the boxes tight—of course the boxes must have tight tops or the boys will fill them with stones—boxes can be used satisfactorily. But my experience in small and growing towns goes to show that boxes are not safeguards. During fires you can save by removing the meters—that is, you can save money by not going to the expense of putting in stopcock boxes, and removing the meters when fires break out. In two years I only lost two or three meters.

MR. SOMERVILLE—I believe in England they do not use such things as stopcocks and boxes. My experience is something like Mr. Lansden's, in the case of a fire.

MR. JENKINS—We do not use a stopcock or box. We find it best to remove the meters and save them instead of the stopcock.

MR. YOUNG—I was just going to say that although in a great many instances, when you want to turn off the gas at the stop-box, you cannot do it—the box is either filled up or something of that kind—in the case of a fire, when the firemen find difficulty in putting out the flames, because of the gas burning in the house and relighting the flames again, if you have the stop-boxes in place you show to the community or the insurance company that your intentions were all right. It was not to save money that you could not shut off the gas, and you might save considerable expense in that way. Insurance companies and the proprietor of the property might claim that, if you had exercised proper caution, and put the stop-box and stopcock in, you might have been able to shut off the gas and there would have been no fire, or very little damage done. On that ground I think it is inadvisable to recommend the gas companies not to put in stopcocks. In some cases they are very convenient. Sometimes when a customer refuses to pay his gas bill, the man you send around to shut of the gas, when the lady of the house discovers what he is after, is met with an axe or something of that kind. He is supposed to go into the cellar; but it is very handy to turn the gas off at the pavement. I do not think we ought to dispense with the stopcock and box at the curbstone.

THE PRESIDENT—I would say, in my own experience, the Company with which I am associated has always been in the habit of using stopcocks and boxes, and we have found, in case of large fires, that it is very useful—in that it saves a great waste of gas. It so happened a short time ago there was a large fire in one of our business blocks on which there did not happen to be a stop-box. There was no possibility of shutting off the gas and so the fire burned out all the gas fixtures and the gas was leaking there for nearly 24 hours before the debris was cleared away so the gas could be shut off. The next question on the list is No. 3:

"In reviving oxide in the off box, without removal of same, is it best to use steam where it will come into contact with the material or blow air through without steam?"

MR. GEO. TREADWAY THOMPSON—My experience has been with one phase of this question only. We have been for some time reviving our oxide in boxes with steam and air by making an attachment at the inlet pipe to a purifier and blowing a light jet of steam through there, drawing our air through the outlet pipes. If there was a blackboard here I could by means of a diagram make the point clear. For the off box there is a connection in the center seal between the inlet and outlet pipes. In injecting steam into your inlet pipe you draw the air down through your outlet and we here have a cover with a slide in it by which the quantity of air entering can be very nicely adjusted, so all danger of setting the oxide on fire is avoided. We have made no experiments with the reviving of oxide by the use of an injector, in which the steam would not come in contact with the oxide, as described, for instance, by Mr. W. A. Wood, before the New England Association last spring; but we hope soon to do so.

MR. YOUNG—I would judge it depended considerably on the condition of the oxide as to whether it would be advisable to introduce steam along with the air for revivifying—if the oxide is new and the oxidation very rapid; if I were doing it I would introduce enough steam to keep the temperature below the firing point. When the oxide becomes older, and the oxidation not so rapid, I would do away with the steam. You require all the air that you can get in without any counteracting to raise the temperature for oxidation. The solution of the question would depend altogether on the condition of the oxide, as to whether it would be necessary to use steam or not.

MR. BREDEL—When in the San Francisco works I saw an apparatus, devised I believe by Mr. Jones, the Superintendent, for reviving which struck me as being very sensible. In the center of the bottom of the purifying box (the box is 24 feet square, or something like that) he has put a 4-inch pipe. In that 4-inch pipe is a steam jet, on the order of a steam jet exhauster. He lifts off the cover of the box and closes the outlet so that the gas cannot be threshed around, then he puts the steam jet on and draws through about four times the amount of air that would be necessary to revivify. He does that to keep the temperature down, and it takes generally from 1 hour to 24 hours to revivify a large box.

MR. THOMPSON—That is precisely the one I have reference to as having been described by Mr. Wood. Doubtless Mr. Jones took that idea with him from Boston.

MR. BREDEL—Yes; so he did.

MR. LANSDEN—As I understand Mr. Bredel, he says to put as much air through it as possible.

MR. BREDEL—Yes; you have to put enough air through it. If you put through exactly the amount of air required to revivify, the oxide becomes hot.

MR. LANSDEN—Several years ago I undertook to revive by the use of a fan. I first made a screen of wire. I used a material which I thought could not burn, and that was broken firebrick, about ½-inch cubes, and iron filings. I tried it in one box and revived that way. I found I could run it up to 500° and clear it entirely of the sulphur. One day, when absent for a few hours from the city, the man who had charge of it—he is one of Mr. Chollar's right hand men to-day—thought he would beat me a little; but when he attempted to take the temperature in the box he broke his thermometer, letting his fan, however, keep on running. He sent up to the city to get another thermometer, and discovered some 20 or 30 minutes latter that the box was on fire. He removed the lid and found the iron and firebrick had about all run together. I had to throw it away. I find that the application of a small amount of steam will prevent the heating, and it takes, I think, pretty nearly 300° to drive the sulphur out. To revive it in two or three hours with the immense amount of air required, as Mr. Young says, you have to be very careful about how old your purifying material is.

MR. BREDEL—At the old station of the San Francisco Gas Light Company, the old oxide took more time and care when being revivified—about two hours; but with new oxide at the new works one hour only was needed. The whole thing is to put *enough* air through it to keep it cool. That is the whole secret.

THE PRESIDENT—Question No. 4 is:

"*After revivifying oxide, why is water thrown on it before replacing it in box?*"

MR. SOMERVILLE—I should think, if the oxide is dry, it is possible for the gas to take some of it and carry it in with it. I put water on it to prevent that.

MR. CHOLLAR—I think Mr. Somerville's idea is that it is put on there to keep it wet.

MR. YOUNG—I dampen it to assist the chemical action. All chemical action takes place in moisture more quickly than in dry.

THE PRESIDENT—Next, we have:

"*Can any one give the facts in regard to the Harris process of gas making?*"

Mr. Lansden—I received a letter a short time ago telling us that some people were organizing a new gas company, in Cincinnati, to operate under the Harris process, and the letter also stated that the process, as the writer understood, was in full operation in Washington. I had heard of the process having made its appearance in Washington, where they are putting up, as I understand it, a small plant. Certain influential men are backing it. I do not like to have a thing of this kind go on without getting information in regard to it. I understood there were quite a number of men in the Western Association who had visited Maysville, Ky., where a Harris plant is said to be operated. It seems they have organized a company and are selling stock, and as I could not give Gen. Hickenlooper—it was he who wrote the letter—any information, I only wrote back to him that three weeks before I heard from him he had offered $100,000 for a 20-day option on Cincinnati. That was all the information I could give him in regard to the process. I have some of their claims as to what they can do, and I think when these "new discoveries" come up the best way is to get at the experience of men who are practical men. The claims that their prospectus makes are wonderful—cheap as daylight, almost; and I thought if some of the gentlemen who had visited Maysville and watched the process, and who were not interested as newspaper men, etc., would give us some of their experience, we might find out something about it.

The President—Has any gentleman been at Maysville who can give us any information on this process?

Mr. Egner—I have not visited Maysville and have not seen the process at work. I have examined the patents, and there is a great similarity between the Harris process and some others I know of. However, if any gentleman here is contemplating the erection of water gas apparatus, and fears to be taken in with an infringing patent, I would like to call his attention to some of the decisions of the Supreme Court in past patent causes. They are good decisions and definitions and stand, and may aid such as are in doubt to decide upon what to do: "An equivalent in patents is defined as a thing which performs the same function, and performs that function in substantially the same manner as the thing of which it is alleged to be an equivalent." "There are two tests of equivalency: *First*, identity of function. *Second*, substantial identity of way of performing that function." "A change of form does not avoid infringement of a patent. Even when a change of form somewhat modifies the construction, the action or the utility of a patented thing, non-infringement will seldom result from such a thing." "A defendant's machine may be better than that covered by the patent in suit; but if that superiority resulted from some addition to the latter, it will have no tendency to avoid infringement." There are a great many gas companies in the United States to-day who wish that they had not infringed a certain patent that you all know of. There is a possibility that some will have to pay for what they do not look for now, the purchasing patented processes or apparatus; it pays to be careful, and perhaps consult others who have had experience in such matters.

MR. LANSDEN—May I read some of the claims of this Harris process?

THE PRESIDENT—If you will not take too much time.

MR. LANSDEN (reading from pamphlet)—"Ten pounds of coal in this process produce 700 cubic feet of gas. The addition of 2 gallons of crude oil raises this amount to something over 1,000 cubic feet. By doubling this quantity of oil the fuel gas can be carbureted up to any desired candle power, and can, therefore, be used for illuminating as well as heating purposes, thus obviating the necessity of two lines of pipe. A machine 14 feet high and about 16 feet in diameter will gasify 20 pounds of coal a minute, and will have a daily capacity of about 3,000,000 cubic feet of enriched gas. As a result of practical evaporative experiment, corroborated by chemical analysis, the gas possesses from 60 to 80 per cent. of the heating power of natural gas. With coal at $2.50 a ton and crude oil at 80 cents a barrel, gas can be put in the holder for about 5 cents per 1,000 cubic feet." Here is some analysis of the Harris gas, purified: Carbonic acid, 0.2; oxygen, 0.4; heavy hydrocarbon, 9.0; carbon monoxide, 18.9; hydrogen, 10.2; marsh gas, 20.3; nitrogen, 41.0. I have talked with some of the parties interested, and they tell me positively they can make it at 3 to 3½ cents per 1,000, and I want to know if it is a fact. I do not want to be taxing my Company to pay the expense of heavy machinery—and I think if some of the Western men who have visited Maysville will only tell me some of the facts it will save me a great deal of trouble, for I have had 50 letters in the last 4 weeks from the West inquiring about this process that is "running so successfully in Washington."

MR. COVERDALE—I will state that I was in Maysville and saw the Harris works. At the time I was there, or the day before, they had a great many capitalists on hand for the purpose of taking stock in the Company. All the work they were doing was to fit a 25-horse power boiler to raise the steam. I talked to the men about it, and went into the place to see the gas burn, but it would not burn. They had a heating stove with but very little heat in it. I talked with them for probably 3 or 4 hours, and when I left my parting salute was, I hope the next man who comes here will know something about it.

MR. HUMPHREYS—I want to call attention to the fact that 10 pounds of coal contains 14,000 heat units. After they have turned it into gas they have either got 420,000 or 520,000 heat units; so it is a very efficient process. (Laughter.)

MR. LANSDEN—I would ask Mr. Humphreys to put that in a different way, for the reason that a great many men would take his remark, as he makes it, as a fact.

MR. HUMPHREYS—Then I will state it in another way. From the coal they put into the furnace they get 4 to 5 times as much heat as the coal possesses. In other words, they have got perpetual motion, which we know is an impossibility.

THE PRESIDENT—Mr. Doan has stated that both Mr. Light and his son have at different times been to Maysville, staying, in some instances, two or three days, only to report on their return that the process was of no account. The next question we have is this:

"*In using iron oxide for purification, it is found to be charged with naphthaline. How can this be removed?*"

MR. THOMPSON—Blow steam through it.

THE PRESIDENT—Question No. 8 is:

"*Are there any successful methods for recovering the iron from the spent oxide?*"

MR. SOMERVILLE—It is spent oxide, is it not?

THE PRESIDENT—Yes; and the answer is, "No."

MR. ODIORNE—Mr. Douglas, I think, could answer that. I talked with him on the train coming down, and he told me he had seen it tried, and that it was quite successful. Burned it, placing the fire under the vessel.

MR. DOUGLAS—I heard of one instance where hot coke was taken out in the yard and thrown on the ground and the oxide shoveled on top of it. They claimed they got most of their oxide back in that way, and it worked all right afterward. That is all I know about it.

MR. ODIORNE—I put in about 1,000 pounds in two retorts, opened the stoppers on the stand-pipes, and I burned it—leaving it in there until the sulphur had all thoroughly burned off, and I was very glad to stop with that amount of experience.

THE PRESIDENT—Question No. 9 is:

"*Are gas companies that own and operate electric light plants satisfied with the profits they are making in this line of their business?*"

(Cries of "No," from all parts of the room.)

THE PRESIDENT—Is there anyone in the room willing to answer this? I think, perhaps, the question is fully answered.

MR. HUMPHREYS—Are they satisfied with the profits they are making in the gas business?

MR. GWYNN—As far as we are concerned, we are fairly satisfied with the returns from our plant. While it is not giving us as good returns for the money invested as the gas plant, it is doing very well, possibly better than most plants. I do not know that any of us are satisfied, but this I think is due to the mismanagement and careless construction of a great many of the plants. A great many of them were thrown up in a reckless way by the contractors, causing a big leakage account to be overcome, who used underwriter's line wire, and followed inferior construction practice. The only way to make any money in the electric light business is to equip the plant in the finest way possible, and by so doing cut down the running expenses.

MR. DOAN—I don't like to see this question go by default, and in vindication of the position taken by our late friend, E. J. King, who, in a paper read before this Association some years ago, strongly advocated the union of the gas and electric light interests, I feel it incumbent on me to give a history of our experience. We have been running our plant now, I should think, some 7 or 8 years, and have met so far with fairly good results; have made a good interest (not large) on our investment. There is, however, one trouble with the electric lighting business; you never get through spending money; there is a continual expenditure, which increases the capital invested. We have lately added a power plant to our station, and I think the solution of electric station business is in that direction. There is good money in the motor business, and I think anyone who operates an electric light plant can well afford to equip it for the electric motor. Our plant was formerly equipped with three high-speed engines, but lately we have substituted for them two 240-horse power Corliss engines, and we are securing most excellent results from the change; for with the new steam boiler capacity we are now running more lamps, the electric street railway (6 motor cars, with trailers), and the gas works, where prior to the substitution of the Corliss engines we could barely run the lamps alone.

MR. JAS. W. DUNBAR—What price do you obtain for your arc and incandescent lights?

MR. DOAN—The arcs are 1,200 candle power, and we get $8 a month for one, $15 a month for two, and $21 for three. We run from as soon as it gets dark in the afternoon or evening until 12 o'clock. The incandescent lamps are metered, and we get 1 cent per ampere hour, with 5 per cent. discount on all bills paid by the 5th of the month.

THE PRESIDENT—Question No. 10 is:

"*What should be the minimum cost per 1,000 cubic feet for purification of water gas? A factor to be considered is the amount of output, and the charges should include cost of materials—lime, sawdust, shavings or chips, copperas, sal ammoniac, iron filings, borings, etc., freight and hauling of materials, labor of preparing the oxide and lime, and all subsequent labor in both the purifying and revivifying rooms.*"

MR. W. L. BROWN—That is a question which I sent to the box because I wish to make some comparison with our own practice, and the question was prompted by the very serious factor of the amount of output. There can be no comparison made between those companies that send out 100,000,000 feet and the small companies. I am interested in the small companies and I will give you our own experience. For the year ending May 31, 1890, on an output of 14,485,400 feet, the cost of purification was 1.9 cents. For year ending May 31, 1891, on an output of 16,735,000 cubic feet, it was 1 cent and 2 mills. For the year ending May 31, 1892 (last two weeks estimated), on an output of 21,436,000 feet, the cost was $\frac{9}{10}$ of a cent.

MR. HUMPHREYS—I would not like to say what the minimum cost is; but I should say $\frac{1}{2}$ to $\frac{3}{4}$ of a cent on an average.

THE PRESIDENT—No. 11 is:

"*Is it possible to ignite an explosive mixture of gas and air from a lighted pipe or cigar? Is there on record an instance of this kind?*"

MR. JENKINS—Those questions came to me just before I left home to come here, and I asked a young man at our gas works to make a few experiments. I have it here written down and will read to you the results:

Ignition of explosive mixtures—Coal gas and air from 1 in 5 to 1 in 10.

Experiment I. By a flame—Exploded.

Experiment II. By a glowing match, after blowing out the flame—Not exploded.

Experiment III. By a piece of wood $\frac{1}{2}$ inch in section, charred and flame blown out—Not exploded.

Experiment IV. By a spiral of paper, after blowing out flame—Not exploded.

Experiment V. By a single strand of iron wire $\frac{1}{32}$ inch in section at bright red heat—Not exploded.

Experiment VI. By same wire, coiled into a spiral, at bright red—Exploded.

Experiment VII. By a lighted cigar—Not exploded.

Experiment VIII. By same cigar while air was being drawn through it—Not exploded.

Three to four trials were made with each substance, the mixtures ranging from 1 in 5 to 1 in 10. Only one trial was made with the spiral of wire (Experiment VI.) The mixture was 1 in 8 in this experiment.

The apparatus used was simply a wide-mouthed bottle, from which the bottom was removed. The bottle was measured and graduated and set in a trough of water. By altering the height of the water in the trough the pressure could be varied. The bottle was filled with the mixtures, and these were tried by removing the cork and plunging the igniting materials into them. The gases were well agitated to cause intermixture. In experiment VIII. the cigar was held in a rubber tube, and air drawn through it while the mixture was caused to impinge upon it under a slight pressure. In experiment V. the reason, I believe, that a single strand of wire did not produce explosion, was that it lost much of its heat by radiation before it could be brought into contact with the mixture. To produce explosion in a gaseous mixture requires a certain initial temperature, which I believe will be found to vary with the density of the gas. When this temperature is reached combustion will take place, whether flame be present or not. As proved by experiment VI., such metals as iron bear and convey this temperature long before they reach the flaming point. Whether or not carbonaceous substances will cause explosion without flame seems to depend upon their density. As seen by experiments II. and III., light glowing charcoal did not ignite the mixture. I believe, however, that had the charcoal been compact, like that made from oak, it would have caused ignition, and I am certain that an electric light carbon heated to redness would have done so. It would seem, however, that substances having the density of tobacco or paper do not produce combustion, unless in actual flame.

THE PRESIDENT—Mr. Ramsdell mentioned to me that he was once up in a balloon with a lighted cigar and that the balloon blew up.

MR. RAMSDELL—The blowing up is not exactly correct. I was filling a balloon at one time, and had about 20,000 feet in it when a storm came up which blew the balloon about considerably and finally tore a rent in one side about six feet long. The balloonist thought we could probably repair it and still make the ascension, and after working a good while we gave the scheme up. But before the gas had escaped from the balloon he asked me if I had ever been in one before. I said no; and we walked into that balloon, staying in there probably a minute. Of course we were entirely surrounded by gas, and did not think of it until I came out of the balloon that I was smoking a cigar while I was in there; but owing to the fact probably that the gas was not in the shape of an explosive mixture it did not explode in that case.

MR. MILLER—I think a good many experiments have been made and show that the explosive mixture necessary is 1 part of gas in 8 of air to 1 part of gas in 16 of air. The reason it did not explode in Mr. Ramsdell's case was because there was too much gas.

MR. YOUNG—In regard to this question I think we ought to be very careful about what goes into print. We might convey the idea, from our remarks here, to people who did not attend the meeting, that it would be impossible to ignite an explosive mixture from a pipe or cigar. I think we ought to make it very plain that it is a very dangerous experiment to go into a purifying house with a lighted pipe or cigar.

MR. SOMERVILLE—I have seen a workman ignite gas from the spark of his pick. I remember, when quite a young man, when assisting the blacksmith to shrink a band on a 16-inch pipe, we fired the gas. The valve had been shut, but gas remained in the pipe and got mixed with the necessary amount of air. The iron did not show red, but I suppose the tapping of the hammer sent a spark into the mixture, which exploded. The blacksmith, being on top of the pipe, got a severe burn, while I, being below, escaped with a fright. It is a serious matter, and too great caution cannot be taken to keep away from fire.

THE PRESIDENT—No. 13 is:

"*What would be an equitable rule for the valuation of ammoniacal liquor from the gas works for seller and purchaser?*"

MR. YOUNG—That, I should think, is subject to variation, according to the demand for ammonia. I do not think you could adopt any rule. Do I understand the question to ask what would be a fair price?

THE PRESIDENT—What would be an equitable rule for the valuation?

MR. YOUNG—That is a different thing.

MR. EGNER—I was connected with a company, not very long ago, when we had a great deal of trouble about that very same thing. We were paid so much per 100 ounces, and the contract specified 100 ounces should mean the amount of ammonia it would take to neutralize 100 ounces of *pure sulphuric acid*. The trouble was to satisfy the contractor as to what was pure sulphuric acid. He was not satisfied with any test at all. The pure sulphuric acid which we bought in the chemical stores, and which was sold as chemically pure, he was not satisfied with. I think it would be well if we could get an expression upon that.

MR. BROWN—It is a matter very easily done. Simply make a standard solution of sulphuric acid, or any other acid.

MR. EGNER—Suppose that the contractor would say: "Well, that is not pure acid." If you read up on this subject, you will find that it is a pretty important one, and that, therefore, some rule ought to be established which would be acceptable to seller and purchaser. I would suggest that we might say the purest acid that can be bought. The matter was finally brought before our President, Mr. McMillin, who decided the purest acid that could be bought should be the standard.

MR. YOUNG—Could not the trouble be avoided in making the contract by saying that the acid which was tested was to be so much Beaume hydrometer.

MR. EGNER—Yes; that would do, but it was not satisfactory in our case.

MR. BREDEL—No; that would not do. The amount of SO_3 and H_2SO_4 varies. It is not the same all the time. He might buy in one place and you buy in another, when you get two different kinds of sulphuric acid.

MR. YOUNG—Still, if it was 66° Beaume, that would settle it.

MR. BREDEL—No; it would not. The acid might be 66° B., and yet have different percentages of SO_3 and H_2SO_4. He buys the test acid in one place and you buy it in another place, and whose acid are you going to use? There you would get into a dispute right away. The strength of the acid would not be the same.

THE PRESIDENT—No. 14 is:

"*What is the best and most equitable way to sell coke—by weight or by measure?*"

I suppose there are as many differences of opinion as there are people.

MR. LANDSDEN—I would suggest that when we have such weather as we have had in Detroit this week, we had better weigh it.

THE PRESIDENT—I find the most satisfactory way to sell it is by weight.

MR. YOUNG—To the company or the buyer?

THE PRESIDENT—Most satisfactory to me. (Laughter.)

THE PRESIDENT—No. 15 is:

"*By what method, or in what manner, can the ammoniacal liquor of small gas plants be most profitably utilized? By small gas plants is meant those carbonizing from 4,000 to 8,000 tons of coal per annum.*"

MR. EGNER—I think by concentrating it and getting as good a price as you can. I know one small company doing that now, and it will get the price of all its machinery on this account back within nine months.

THE PRESIDENT—I have been asked by Mr. Humphreys to remind the members present to take action immediately upon returning home concerning their subscriptions to the World's Fair. He does not want you to forget to do this at once, before your enthusiasm cools off. He says it is absolutely necessary to have all the cards of subscription in within two weeks in order to determine what the Gas Industry Council wish to do in the matter—whether they will go ahead or whether they will give up the project altogether. Bear this in mind, please, and immediately upon your return attend to it. We have yet to hear from two Committees this afternoon. One of these is the Committee on Memorials, of which Mr. McIlhenny is chairman.

MR. MCILHENNY—I am very sorry, Mr. President, but I was not aware of that fact until you spoke of it now.

On motion of Mr. Humphreys the matter was left to Mr. McIlhenny.

REPORT OF COMMITTEE ON FINAL RESOLUTIONS.

The President called for the report of the Committee on Final Resolutions. Mr. Jenkins (Chairman) made the following report, which, on motion of Mr. Ramsdell, was adopted and ordered spread on the minutes:

Your Committee on Final Resolutions beg leave to report the following: The members of the Western Gas Association desire to hereby express a hearty and unanimous vote of thanks as follows: To the Mayor of Detroit, Mr. H. S. Pingree, for kind expressions toward the gas industries in his address; to Messrs. Jerome Croul, Isaac C. Baxter, W. J. Chittenden and F. P. Byrne, of the Michigan Natural Gas Company, the local Committee of Arrangements, for the many courtesies extended and excellent provisions for our pleasure and entertainment while in Detroit; and also to the Detroit Gas Light Company, the Detroit Pipe and Foundry Company, the Michigan Natural Gas Company and the Michigan Ammonia Works, for substantial backing to the local committee; to the ladies of Detroit, who have so handsomely entertained the ladies of our Association; to the press of Detroit, for very fair and impartial reports of our proceedings published in their daily papers; to the President of this meeting, for his able address, his courteous treatment of each and every member present, and his excellent management of the sessions of our Detroit meeting; and to our able and efficient Secretary, to whom, more than any one individual member, is due the success of this meeting.

Respectfully submitted,
E. H. JENKINS,
C. W. BLODGETT,
Committee.

The Association then adjourned.

PROCEEDINGS

OF THE

WESTERN GAS ASSOCIATION

SIXTEENTH ANNUAL MEETING,

HELD AT

CHICAGO, ILLS.,

May 17, 1893.

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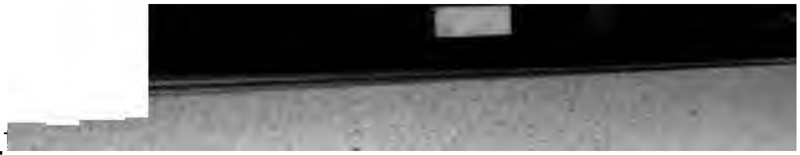

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B E Chollar

PROCEEDINGS

— OF THE —

WESTERN GAS ASSOCIATION.

SIXTEENTH ANNUAL MEETING,

— HELD AT —

"KINSLEY'S," CHICAGO, ILLS.,

May 17th, 1893.

FIRST DAY—MORNING SESSION.

The meeting was called to order at 10 A.M., Wednesday, May 17, by the President, Mr. B E Chollar, of St. Louis. Mr. A. W. Littleton, of Quincy, Ill., occupied the Secretary's desk.

The President having invited visiting friends and those about to become members to take seats in the convention, announced that the regular order of business would be proceeded with.

On motion of Mr. Cowdery, the reading of the minutes was dispensed with.

ROLL CALL.

Honorary Members.

Joseph R. Thomas, N. Y. City.
A. B. Slater, Providence, R. I.
F. E. Barker, Boston, Mass.

Active Members.

Averill, A. T., Cedar Rapids, Ia.
Bauer, P., Belleville, Ills.
Beal, W. R., N. Y. City.
Boardman, A. E., Macon, Ga.
Bolcom, H. C., Winona, Minn.
Branch, A. H., Denver, Col.
Brown, W. L., Evanston, Ills.
Burns, G. B., Austin, Ills.
Butterworth, I., Columbus, O.
Butterworth, W. C., Rockford, Ills.
Cathels, E., Butte, Montana.
Chollar, B. E., St. Louis, Mo.
Christie, W. H., Corning, N. Y.
Clark, W., Philadelphia, Pa.
Collins, C., Green Bay, Wis.
Corscot, J., Madison, Wis.
Cowdery, E. G., Milwaukee, Wis.
Darrah, S. M., Wheeling, W. Va.
Davis, D., Iowa City, Iowa.
Diall, M N., Terre Haute, Ind.
Dickey, R. R., Dayton, O.
Doan, F. M., Jacksonville, Ills.
Dunbar, J. W., New Albany, Ind.
Eaton, W. M., Jackson, Mich.
Egner, F., St. Louis, Mo.
Elbert, V. L., San Francisco, Cal.
Evans, C. H., Chicago, Ills.
Faben, C. R., Jr., Toledo, O.
Faux, J. A., Pittsburgh, Pa.
Ferrier, J., Columbus, Ga.

Fitz, R. F., Elgin, Ills.
Freese, F. W., Laporte, Ind.
Fullagar, W. E., Port Jervis, N.Y.
Gerould, H. T., Englewood, Ills.
Howard, J. B., Galena, Ills.
Howden, J. J., Muskegon, Mich.
Jenkins, E. H., Columbus, Ga.
Johnston, W. J., Fort Smith, Ark.
Keller, C. M., Columbus, Ind.
Kennedy, J. M., Rockford, Ills.
Knight, C. S., Fort Wayne, Ind.
Lansden, T. G., Washington, D.C.
Light, J., Dayton, O.
Littleton, A. W., Quincy, Ill.
Lukins, W. H., Streator, Ills.
MacKay, C., Watertown, N. Y.
McDonald, W., Albany, N. Y.
McMillan, G., LaCrosse, Wis.
Miller, A. S., Chicago, Ills.
Mitchell, K. M., St. Joseph, Mo.
Montgomery, J., Sedalia, Mo.
Morgans, W. H., Pontiac, Mich.
Murdock, G. T., Elkhart, Ind.
Murdock, J. W., Ottawa, Ills.
Odiorne, W. H., Springfield, Ills.
Penn, J., Washington C. H., O.
Perkins, B. W., South Bend, Ind.
Post, I. S., Chattanooga, Tenn.
Powell, C. S., Richmond, Ky.
Ramsdell, G. G., Philadelphia, Pa.
Raynor, C. H., Adrian, Mich.
Rice, E. S., Logansport, Ind.
Rowe, J. J., Eau Claire, Wis.
Runner, Z. T. F., Freeport, Ills.
Shelton, F. H., Philadelphia, Pa.
Shores, L. W., Kankakee, Ills.
Smedberg, J. R., Chicago, Ills.
Somerville, J., Indianapolis, Ind.
Spencer, R., Burlington, Iowa.
Steinwedell, W., Quincy, Ills.
Stratton, J. W., Valparaiso, Ind.
Stratton, R. J., Decatur, Ills.
Thompson, G. T., St. Louis, Mo.
Tracy, W., Leavenworth, Kas.
Walbridge, H. D., Grand Rapids, Mich.
Wallace, Wm., Lafayette, Ind.
Ward, B. A., Michigan City, Ind.
Whipple, H. S., Rockford, Ills.
Williamson, J., Chicago. Ills.
Wilson, W. M., Hot Springs, Ark.

Associate Members.

Bradford, G., Chicago, Ills.
Bradley, C. D., Chicago, Ills.
Bredel, F., Milwaukee, Wis.
Brown, E. C., New York City.
Cressler, A. D., Fort Wayne, Ind.
Dell, J., St. Louis, Mo.
Dickey, C. H., Baltimore, Md.
Dickey, P. S., Chicago, Ills.
Felt, H., Jr., Cincinnati, O.
Floyd, F. W., New York City.
Goodwin, W.W., Philadelphia, Pa.
Guldlin, O. N., Fort Wayne, Ind.
Harper, H. D., Chicago, Ills.
Hauk, C. D., Chicago, Ills.
Hayward, S. F., New York City.
Higgins, C. M., New York City.
Hubbard, F. M., Chicago, Ills.
Kendall, J. R., Terre Haute, Ind.
McClary, N. A., Chicago, Ills.
McIlhenny, J., Philadelphia, Pa.
Morava, W., Chicago, Ills.
Morrell, E. E., Chicago, Ills.
Moses, F. D., Chicago, Ills.
Newman, C. V., Chicago, Ills.
Osius, G., Detroit, Mich.
Persons, F. R., New York City.
Roots, D. T., Connersville, Ind.
Roper, G. D., Rockford, Ills.
Russell, D. R., St. Louis, Mo.
Smythe, A. E., Chicago, Ills.
Stacey, W., Cincinnati, O.
Stout, J., Chicago, Ills.
Stratton, S. S., Chicago, Ills.
Twining, E. H. B., Chicago, Ills.
Van Wie, P. G., Chicago, Ills.
Waugh, F. K., Chicago, Ills.
Weber, O. B., New York City.
Wickham, L., St. Louis, Mo.
Worcester, F., St. Louis, Mo.

The President then read the following address:

ADDRESS OF THE PRESIDENT.

Sixteen years ago, in a little back room on the second story of the St. Louis Gas Company's office, there met sixteen progressive western gas men. The object desired was mutual help through united action—the doubling up of teams to pull through difficulties in which each would flounder singly. The result accomplished was the Western Gas Association. The times were ripe for the enterprise. The Association was successful from its birth, and to-day nearly sixteen times sixteen active and earnest members will assemble here to confirm the wisdom of that prophetic few and continue the work on the lines intended by them.

Previous to 1860, an American Gas Association, if indeed possible, would have had a precarious existence. Not that such an institution was not needed, or could not have accomplished good work and served a good purpose, but the tendency at that time was more to concealment than to co-operation, and neither advice nor assistance was looked for or desired. The selling price of gas in most cases was governed by conventional cost and corresponding profit. There was no high-grade competing light on the market, and the gas companies held control of the situation.

The business was conducted in a happy-go-lucky sort of way, fairly profitable, but not extremely prosperous; but sufficiently so to make gas companies contented with the prevailing conditions, and prefer listening to the kicks of their customers to making any extraordinary effort toward reduction in prices.

Consumers had the option of gas at $3 to $5 per 1,000 on the one hand, and whale oil, camphene or tallow dips on the other. Prices were not excessive under the circumstances, for there are records to show that gas that cost as high as $3.75 was sold as low as $4.50 per 1,000. Gas company officers were as honest as their customers, and treated them quite as civilly as their customers would have treated them if the conditions had been the reverse. The customers thought their gas bills were too big, just the same as they do now, but nobody was cheated. Of the two parties concerned, however, the gas companies had the better of it, for the reason that they established the price and the consumers had to pay it.

In 1859 Drake "struck oil." The stuff was villainous to the smell, but the wells gushed like the cataract at Lodore. The oil was truly a crude article, but it satisfied a requirement and filled a long-felt want.

After a few years of oscillation between failure and success, the illuminating oil business became firmly established, and the relative conditions that had before existed between gas companies and their customers became transposed. The companies could no longer maintain prices at their pleasure, and thereafter profits were to be gauged by cost of production and not by vote of directors.

Capital is haughty and self-reliant when successful, but timid and faint-hearted when unfortunate. Gas men became more unreserved and communicative among themselves, and were not so well satisfied with themselves as they formerly had been. They began to realize the fact that something was needed to counteract the existing unlucky condition of affairs, and were ready to listen to suggestions in regard to reductions in cost, even if the proposed reductions were small.

In order to maintain profits at reduced prices, it was necessary to convert what had been simply a business vocation into a scientific industry. The successful accomplishment of this object required organized and united action, and a cumulation of knowledge, information and experience—in short, the Gas Association.

This assistance and support was invoked, not for business advice or for financial counsel, but for expertness and skill in manufacture. The owners of gas property had managed their business affairs in their own way long before such a thing as a Gas Association was thought of, and they will continue to do so in future.

It was the producing and not the selling half of the business where the improvement was wanted. If we were engaged in furnishing natural gas instead of the manufactured article, and were certain that the supply would ever continue, both in regard to substance and the pressure necessary for its own distribution, the interest in Gas Association work would be greatly diminished, and the attendance at our meetings would be correspondingly less.

It is plain, therefore, that the benefits to be derived from organized and united action are greater in the manufacturing than in the distributing, but small and of questionable value in the business department.

The closer we adhere to the true and logical purpose of Association work the better it will be for us. It is easy and quite natural for us to digress from our subject, but there is no profit to be gained by so doing. Not that we should confine ourselves entirely within the manufacturing and distributing departments to the exclusion of the rest, for we make gas to sell, and the selling is half of the business; but the money-getting part, although of equal importance, is conducted more by tact and intuition and is less to be benefited by co-operation than the others. We would be more likely to take counsel with others in regard to the construction of a condenser than to keeping a cash acacount. We would plod through files of the journals to settle a question of purification, when we wouldn't turn a leaf to get an opinion on a sliding scale of prices.

Our printed proceedings are valuable, and will be read and studied years hence. We should, therefore, be careful to keep to our subject, and think, write and talk to the point, remembering, always:

"A chiel's amang ye takin' notes,
And faith, he'll prent it."

Some years ago, in criticising the proceedings and methods of Gas Associations in general, it occurred to the editor of the *Journal of Gas Lighting* that the average American gas engineer is a man of business first and engineer afterward. The matter was much talked of on this side of the water and highly resented, not only in conversation, but also in some of the journals. It was regarded by many as a direct slur upon the ability of the American gas engineer. A close reading of the article, however, might lead to another and a different impression, and suggest the possibility that the editor intended to pay us a sly compliment; for if the business tact of the American prompts him to make use of the American engineer who is a business man first and engineer afterwards, in preference to the Englishman who by inference is engineer first, how does it place the American as an engineer, and how as a business man in comparison? It would seem that the criticism is based upon an incorrect impression of relative conditions in the two countries.

In England the ownership of gas property is largely obtained by inheritance, while in this country it has chiefly been acquired in the general scramble by the owners themselves. The average Yankee generally knows something of the business in which he has been successful, and thinks he is a pretty good all-round engineer himself, even if he finds it convenient to employ a professional for details. It is quite natural, therefore, for those who have accumulated gas property by their own industry and enterprise to talk more cash than chemistry, and if they incline more to business than to benches, it by no means proves them lacking in engineering ability, but might indicate that our proceedings are inclined to be somewhat rambling and desultory; and we might, therefore, take a valuable hint from the *Journal* and do less irrelevant talking at our sessions, and discuss our business affairs during the intermissions.

Competition is gradually reducing prices, and we are looked to, if not expected, even, to meet the cuts with corresponding reductions in the cost of production. If we are to undertake the job, we will require all the "theoretical" and all the "practical" knowledge that we can get, and still have need for more.

It is fortunate for the industry that the technical schools are now turning out useful young graduates instead of the undeveloped pedants that some of the others are furnishing. They are sometimes spoken of as "kindergarten engineers"—but the young fellows are all right. They have much to learn, but they have a remarkable facility for picking up practical ideas, and many of them will be at the top before the old-timers are all gone. Gas engineering can neither be taught successfully in schools, nor does the practice of it demand a scientific education as a requirement. The Gas Association, in connection with our daily practice, is the best school of gas engineering.

Let us, therefore, strive to promote its usefulness, maintain its efficiency and uphold its dignity, and by so doing advance our own interests and enhance the value of the property that we represent. The Association will make the engineer, and the engineer will make the Association.

There are two important subjects that will demand your serious thought and careful attention during the ensuing year. One of them is the *development* of a better efficiency by gas burners, and the other is the destructive action of electric currents upon mains and services.

The burner question received a timely introduction at the last Ohio meeting, and we owe it to ourselves and to our customers that we act upon the suggestions of Mr. Butterworth. Good gas is the rule, and bad the exception; but bad combustion of it is the rule, and good the exception. This question opens up a field for greater profit to gas companies than any other that can be proposed; and the time is not far distant when it will receive the full measure of attention that its importance demands. If with half the value of our gas wasted in burning we can successfully compete with the bottled glow-worms maintained by our electrical friends, what may we do when we shall have developed the full efficiency of our product and the electricians shall have advanced their prices to a profitable rate?

When a service pipe becomes so badly corroded in one week that a new one is needed, one would naturally think that something is wrong; but when services by the dozen have to be renewed after one to three months' use, the question becomes startling. It may appear strange to those who have not yet had experience in this line, but such are the facts, as the samples brought for your inspection will show. At present the greatest action is directly under electric railway tracks in the immediate vicinity of power stations. The trouble seems to be local, and not at all general. The only remedy that so far suggested itself is to have two mains on streets occupied by electric railways, thus avoiding the necessity of going under the track with the service pipes. The matter is of the utmost importance, and demands prompt and energetic investigation on our part.

The grim messenger has made his customary demand upon us since our last meeting, and several of our members have passed to the mysterious realm. You will no doubt take such action as may be required to express to their families our sorrow for their bereavement and our respect for the memory of our departed friends.

In conclusion, I beg leave to express my sincere thanks for the high honor which you have conferred upon me in selecting me to preside over your deliberations, and I trust, by your kind indulgence, we may be able to dispose in a satisfactory manner of such business as you may desire to entertain.

COMMITTEE ON PRESIDENT'S ADDRESS.

MR. WALTON CLARK—Although I appreciate the improbability of a committee, however complete it may be, being able to add anything to the able and carefully considered address to which we have listened, yet, in honor of the President, I move the appointment of a committee to report on his address, and that the committee be instructed to report at their earliest convenience. The motion was carried, and Messrs. Walton Clark, J. R. Smedberg and Charles R. Faben, Jr., were appointed as such committee.

SPECIAL COMMITTEES.

THE PRESIDENT announced the appointment of the following Special Committees:

ON NOMINATION OF OFFICERS—J. Somerville, Frederic Egner, G. G. Ramsdell, J. B. Howard, T. G. Lansden.

ON PLACE OF NEXT MEETING—E. G. Cowdery, William Tracy, James Ferrier, J. W. Stratton, H. D. Walbridge.

ON RECEIVING AND INTRODUCING MEMBERS—E. H. Jenkins, Eugene Printz, A. S. Miller.

ON MEMORIALS—I. Butterworth, R. R. Dickey, F. M. Doan.

ON FINAL RESOLUTIONS—A. E. Boardman, I. Butterworth, G. T. Thompson.

REPORT OF BOARD OF DIRECTORS.

THE PRESIDENT—Next in order of business is the report of the Board of Directors.

The Secretary read the following:

CHICAGO, ILLS., May 16, 1893.

A regular annual meeting of the Board of Directors of the Western Gas Association was held this morning, at 10 o'clock, at which were present the following members: B. E. Chollar, E. H. Jenkins, R. R. Dickey, D. Davis, F. M. Doan, W. L. Brown, J. W. Dunbar, Jas. Montgomery, H. D. Walbridge and A. W. Littleton.

On motion, the reading of the minutes of the last meeting of the Board was dispensed with.

The Board recommended that the following papers, which had been prepared for presentation at the forthcoming meeting, be submitted to the Association in due course:

"Residuals; Ideas Concerning Them Suggested by the Present Outlook," by Mr. James Ferrier.

"Wrinkles," by Mr. Geo. Treadway Thompson.

"The Duties of Gas Companies to their Customers," by Mr. H. D. Walbridge.

"Gas Analysis," by Mr. O. O. Thwing.

"Wood Gas During the War," by Mr. Jas. R. Smedberg.

In accordance with the requirements of the By-Laws, the Board appointed Messrs. F. M. Doan, J. W. Dunbar and D. Davis a committee to examine the books and accounts of the Secretary-Treasurer and report thereon to the Association.

The committee subsequently reported the following as the result of the examination in question:

Receipts.

To membership fees ....$	160 00	
" dues	860 00	
" sale of badges	108 50	
" balance from May 1, 1892	236 46	
		$1,364 96

Disbursements.

By Secretary's salary..............$	400 00	
" sundry bills, as per vouchers.....	623 75	
" balance, cash, May 1, 1893.....	341 21	
		$1,364 96

The following members of the Board were appointed a committee to examine and report on applications for membership: J. W. Dunbar, W. L. Brown, Jas. Montgomery.

The Secretary here read the following communication from Mr. E. C. Brown, publisher of the *Progressive Age:*

New York, May 13, 1893.

Board of Directors Western Gas Association—Gentlemen: In submitting the accompanying request, signed by 101 active members of your Association, I wish it to be understood that my effort in securing the same was not the result of intention on my part to interfere with the harmony or good fellowship prevailing in the assemblages of the Western Gas Association, nor to appear in any sense to dictate to your honorable body. It is also due to myself to repeat what is well known to several of your present Board, but may not be to some—that I have on several occasions sought the privilege of publishing in *Progressive Age* an authentic report of the proceedings of the Western Gas Association. These ineffectual attempts on my part to secure action, first through your Board, and again in open meeting, are already matters of history in Western Gas Association affairs.

At the Louisville meeting, in 1891, your President saw fit to refer to the subject of reports of your proceedings, using this language:

"Mr. E. C. Brown, publisher of *Progressive Age*, and Mr. George W. Graeff, Jr., managing editor of *Light, Heat and Power*, who are both honored associate members of this Society, have sent me protests as individual members, as well as in their capacity as editors of these technical journals, in regard to the methods observed by this Association in the publication of our records. Although the officers of this Association have been charged with partiality, the said officers have nothing whatever to do with it, and have only done which was authorized by the Association, and have declined simply to overstep their authority. Every member of this Association ought to know."

Mr. Egner thereupon recommended that a committee of five members be appointed, who should hear the views and arguments of all concerned, or who desire to be heard upon the subject; that said committee should report their findings and recommendations to the Association on the following morning.

The Committee on President's Address consisted of Messrs. E. H. Jenkins, Wm. Steinwedell, I. S. Post, J. W. Murdock, and A. T. Averill. After the usual remarks on the President's Address and sundry recommendations, the question at issue was turned down in these words:

"We suggest that said Mr. George W. Graef, Jr., managing editor of *Light, Heat and Power*, and Mr. E. C. Brown, publisher of *Progressive Age*, be referred to the Board of Directors, as we think it is their duty to consider such questions."

In the meantime, one year has intervened in which action could have been taken by your Board, and none was taken. Mr. Egner tells the members in his address that "The said officers [meaning the Board of Directors] have nothing whatever to do with it," and "have declined simply to overstep their authority." It would then appear that, in the absence of assent on the part of the members, the Directors remain powerless to act. Therefore, in supplying the unequivocal endorsement of so many responsible "Active" members (active in spirit as well as in name), as will be found attached to the accompanying requests, I feel that I have placed before your Board all the needed evidence to enable you to pass upon the question involved, and to act in accordance with your duty toward yourselves and your fellow members.

That you may know the gentlemen who deem it for the best interests of the Western Gas Association that action on this matter should be taken, and have placed their signature to these requests without "undue influence," I beg to submit a true copy of the letter which was sent by me, together with the circular, barring a very few letters differently worded, to men whom I know to be my personal friends.

(Copy of letter sent members accompanying circular.)

"My Dear Sir: Please do me the kindness to read the enclosed circular addressed to the Board of Directors of the Western Gas Association, and if you find nothing there inconsistent with what you deem just and proper, kindly affix your signature to same and return to me at your earliest convenience in the accompanying stamped envelope.

"Fraternally."

The tenor of this letter is such as to relieve me from suspicion that I have attempted to persuade any one, but on the contrary its wording clearly shows an intention to provoke criticism of the question and cause careful consideration of the same.

I have been informed by certain officers of your Association that "the doors are open to *Progressive Age*. Let it send its reporter to the meetings and get its own report." This could perhaps be done; but in answer I would say that I am unwilling to send a stenographer, inexperienced in the technical phraseology of a meeting of gas engineers, and print his report against a report that bears the word "Official." I need not say to you, veteran engineers, that the remarks of speakers at our meetings are frequently sent to them for revision, thereby changing important paragraphs and sentences. Now, if by chance my stenographer failed to note the request of a member in this particular, my paper's report would not read with that of my official contemporary, thereby casting discredit upon the report appearing in my paper. But this is not the sole objection. I believe that the proceedings of any society of gas men should be open to the journals that are untiring in their labors and devotions to develop the industry in which we are all so much interested, and, therefore, instead of placing stumbling blocks in the way of securing full and authoritative report of proceedings, it should be the first duty of those having the best interests of a Gas Association at heart to make the way easy and the burden of expense as light as lies within their power to do. Furthermore, I would ask you to consider the sending of "Notices" announcing meetings to be held, papers to be read, hotel accommodations, railway rates, etc., to all journals recognized by the gas fraternity as published in its interest, and not confine their issuance to a single journal, as has heretofore been the custom. I do not ask you to change the official organship. *Progressive Age* does not seek such title from the Western Gas Association, nor from any other Association of Gas Engineers, and had I to vote on this feature I should cast my vote to let this title remain in its present tranquil state.

In conclusion, permit me to say that I ask your consideration not alone in the interest of *Progressive Age*, but in that of the members of your Association to the extent of 101 names, believing in the long run the wisdom of a broad and liberal policy in this matter as in all others will not only strengthen your Society but win it many new friends. I will add that I now pledge *Progressive Age* to take one copy of the proceedings of the Western Gas Association, to be provided under the direction of your Secretary, and pay its just proportion of the expense attending its compilation, and to publish the same in its entirety in the first number issued by my journal after the close of the meeting, provided the Secretary sends me the manuscript complete, to reach my hands four clear days preceding the date of my issue.

Pardon the length of this communication; and, finally, I beg of you to decide this question now, for it is one that will likely arise to vex and annoy this and subsequent meetings of your Board until finally settled.

Respectfully submitted,

E. C. Brown.

After a lengthy discussion of the question referred to in Mr. Brown's letter, the following resolution was adopted by the Board:

Whereas, The petition of Mr. E. C. Brown, publisher *Progressive Age*, having been duly considered by the Board; and,

Whereas, It having been found that at the present time, and for several years past, the proceedings of the Association, together with all notices and communications belonging to the meetings, have been obtained, compiled and published without any expense to this Association; and also that the privileges of furnishing a stenographer and having full access to our meetings are now accorded to each of the gas journals on an equal footing; threfore,

Resolved, That we see no reason to make any change in the present rules governing reports of our proceedings, and recommend that they stand.

It was moved by Mr. Doan, and carried, that this Board recommend to the Association that on this, the 16th annual meeting of our organization, the business sessions of the Association be confined to one day, viz., Wednesday, May 17th, and that, if necessary, a meeting be held on the evening of said day for the final transaction of such business as may be brought before the Association.

No further business appearing, the Board here adjourned.

A. W. Littleton,
Secretary.

REPORT OF AUDITING COMMITTEE.

The committee appointed by the Board of Directors to audit the books and accounts of the Association would respectfully report the books neatly kept and the accounts correct.

F. M. Doan,
Jas. W. Dunbar,
D. Davis,
Committee.

On motion of Mr. Ramsdell, the report of the Board of Directors was accepted.

REPORT OF COMMITTEE ON PROPOSED REVISION OF CONSTITUTION AND BY-LAWS.

The President—We will now listen to the reading of the report of the Committee on the Revision of the Constitution and By-Laws.

The Chairman of the Committee, Mr. Ramsdell, read the following report:

Constitution and By-Laws of the Western Gas Association.

Preamble.

Whereas, It is necessary that those to whom is intrusted the manufacture and sale of gas for illuminating and other purposes should endeavor, by every means within their power, to improve its quality to the highest and reduce its cost to the lowest practicable limit, thereby meeting the best expectations of both producer and consumer; and, believing that by united action only can results so desirable be accomplished, we do hereby ordain and establish this Constitution for the Western Gas Association.

CONSTITUTION.

ARTICLE I.—Sec. 1. Only officers and regular employees of gas companies shall be eligible for election to active membership.

Sec. 2. Any person who may be directly or indirectly connected with the gas industry, or who may be skilled therein, shall be eligible as an associate member of this Association. Such members shall be proposed, balloted for and received in the same manner, and be subject to the same fees and annual dues as active members, and shall be entitled to all the privileges and courtesies of the Association, except the right to vote or hold office.

Sec. 3. Election to membership shall be by ballot, and a three-fourths vote shall be necessary to elect.

ARTICLE II.—Sec. 1. The officers of this Association shall consist of a President, two Vice-Presidents, and a Secretary-Treasurer, who shall be elected for one year.

Sec. 2. There shall also be eight Directors, four of whom shall be elected at each annual meeting, and whose term of office shall be for two years: provided, that upon the adoption of this Constitution and By-Laws the first Board elected thereunder shall be composed of eight members, four of whom shall be elected for one year and four of whom shall be elected for two years.

Sec. 3. The retiring President shall be, ex-officio, a Director for the next following year: all other officers shall be elected by ballot.

Sec. 4. All officers shall retain their positions until their successors have qualified.

ARTICLE III.—Sec. 1. The management of the affairs of the Association shall be entrusted to the officers and Board of Directors, under the general direction of the members in convention.

Sec. 2. A majority of the Board shall constitute a quorum, and the Board shall have power to fill any vacancies that may exist therein.

ARTICLE IV.—Only active members shall vote or hold office, but no voting by proxy shall be allowed.

ARTICLE V.—The Association shall have power to enact, amend and enforce all necessary by-laws and rules; to provide penalties for their violation: to assess and collect fees and dues for membership; and to provide a benefit fund for the relief of members and their families.

ARTICLE VI.—Any proposition to amend this Constitution shall be submitted at a regular meeting, and seconded by a majority of all active members present: the proposition shall not be acted upon until the next regular meeting, when, if approved by two-thirds of all the active members who may be present at said meeting, it shall become a part of this Constitution.

BY-LAWS.

ARTICLE I.—*Annual Meetings.* The annual meeting of the Association shall be held on the third Wednesday in May of each year, at such place as shall be determined upon at the preceding annual meeting, at which time the election of officers shall take place and annual reports and settlements be made. At each annual meeting the President shall present an address, setting forth his official acts and such general items and recommendations as he may deem of advantage to the Association. All general business of the Association shall be transacted at these annual meetings, and the following shall be the order of business:

Calling the roll and reading of minutes.
President's address.
Presenting applications for membership and balloting.
Introduction of new members.
Reports of standing committees.
Reports of special committees.

Miscellaneous business, which may be laid aside informally and taken up at any time.

Special order for the presentation of papers, drawings or models, or other matters of interest to the Association entitled to consideration under its rules, in the discussion of which all the members shall be entitled to participate, and such special order may be considered at any time by vote of the Association.

ARTICLE II.—*Applications for Membership.* Any person desiring to become a member of this Association shall make his application in writing, giving name, residence and occupation, with proper references, and signed by two members of the Association; but no such application shall be acted upon until the fee for membership is paid.

ARTICLE III.—*Fees and Dues.* Sec. 1. The fee for membership shall be ten dollars, which shall include dues for the first year, and the yearly dues shall be five dollars, payable annually in advance thereafter.

Sec. 2. The Secretary shall drop from the roll the name of any member who shall be in arrears for two years' dues, after giving thirty days' notice.

Sec. 3. The Board of Directors shall have power to reinstate any member who, for non-payment of dues, has been suspended or dropped from the roll, when such member shall have paid the full amount due at the time his membership ceased.

ARTICLE IV.—*Duties of Officers.* Sec. 1. The President, or in the event of his absence the Vice-Presidents, in their order, shall preside over meetings of the Association or of the Board of Directors. He shall enforce all laws and rules of the Association, and shall appoint all committees not otherwise provided for. He shall decide all questions of order, subject only to an appeal, but in all such cases it shall require at least a majority of the members present to overrule his decision. He shall sign the records and have general supervision of the affairs of the Association.

Sec. 2. The Secretary-Treasurer shall attend all meetings of the Association or of the Board of Directors, shall have charge of the books, papers and other property of the Association, and perform such other duties as may properly belong to his office.

ARTICLE V.—*Quorum.* A quorum for the transaction of business shall consist of not less than 15 members; but a smaller number may adjourn from day to day for not more than three days; and in case of the absence of the President or other proper officers they may select a Chairman to preside over the meeting.

ARTICLE VI.—*Board of Directors.* Sec. 1. The Board of Directors shall meet at least once in each year, on the day preceding the annual meeting of the Association, at which time they shall determine in regard to the propriety of the various papers, drawings, models or other matters constituting the special order, being laid before the Association.

Sec. 2. When in the judgment of a majority of the Board of Directors it shall be deemed advisable to change the place or date of meeting, or both, as designated by the Association at its last annual meeting, the Board shall have power to make such change or changes.

Sec. 3. Said Board shall annually, immediately after its own organization, elect a Finance Committee of three from its own number, who shall have power to examine at any time the books and accounts of the Secretary-Treasurer; said committee shall also, on the morning of the first day of the annual meeting, examine the report of the Secretary-Treasurer, audit his accounts and report thereon to the Association, provided that no officer whose accounts may be subject to examination shall, under any circumstances, be a member of such examining committee. The Board of Directors, at the same meeting, shall also appoint a committee of three from their own number, whose duty it shall be to examine and report on applications for membership.

Sec. 4. The Board of Directors shall also cause a record of its proceedings to be kept, which shall be submitted to the Association during the first day of the annual meeting.

ARTICLE VII.—*Executive Committee.* The President, the two Vice-Presidents and the Secretary-Treasurer shall constitute an Executive Committee, whose duty it shall be to meet at least once in each year, not less than 90 days before the annual meeting of the Association, for the purpose of choosing subjects and assigning authors for the papers which shall be presented for the consideration of the Association at its next annual meeting.

ARTICLE VIII.—*Papers, Drawings, Etc.* All papers, drawings, models, etc., submitted to the Association at its annual meetings shall remain the property of those presenting the same.

ARTICLE IX.—*Rejected Applications.* If any person proposed for membership shall, upon being balloted for, be rejected, no notice of such proposal shall be incorporated in the minutes.

ARTICLE X.—*Trials and Punishments.* Any member may, upon conviction of violating any of the laws or rules of the Association, or of conduct unbecoming a gentleman, be suspended for a definite time, or expelled from the Association, by a vote of at least three-fourths of all the members present; provided, that any such accused member shall be furnished with a copy of the charges against him at least 10 days before his trial, and be allowed an opportunity to appear either in person or by counsel for his defense.

ARTICLE XI.—*Rules.* The business sessions of the Association shall be conducted in accordance with the requirements of Robert's Rules of Order.

ARTICLE XII.—*Special Meetings.* Special meetings of this Association may be called by the President, by and with the written consent of a majority of the Board of Directors. He shall cause notices to be issued to all the members of the Association at least 30 days prior to such meetings; said notices to state the business for which such meeting has been called, and no other business than that mentioned in such notices shall be considered.

ARTICLE XIII.—*Amendments.* These By-Laws may be altered or amended only in the following manner:

Sec. 1. Any proposition to alter or repeal an existing By-Law shall be presented in writing during an annual meeting, at any time before its adjournment, seconded by not less than three members, shall be read twice, and if approved by two-thirds of all the active members present, shall become a part of these By-Laws; but no such alteration or amendment shall affect any question pending at the time of its adoption.

Sec. 2. Any additional section to these By-Laws, not in conflict with any existing By-Law, may be adopted at any annual meeting upon being presented in writing, duly seconded, read twice, and approved by at least two-thirds of all the active members present.

DISCUSSION.

MR. LANSDEN—I ask to have Section 1 of Article II. of the present Constitution read, and in connection with it Section 1 of Article I. of the proposed Constitution.

MR. RAMSDELL—The present Constitution provides, in Section 1, Article II., that "No one shall be eligible for active membership in this Association unless he is a regular gas engineer or superintendent, or an actual executive officer of a gas company." The proposed amendment reads: "Only officers and regular employees of gas companies shall be eligible for active membership."

MR. LANSDEN—As I understand the amendment, it permits any employee, whether he be a gas engineer or not, to become an active member?

Mr. Ramsdell—Yes; and in respect to Associate Members the present Constitution provides: "Any person, directly or indirectly connected with the management of gas works or gas machinery, or who may be skilled therein, shall be eligible as an Associate Member of this Association." The proposed section as to Associate Members reads: "Any person who may be directly or indirectly connected with the gas industry, or who may be skilled therein, shall be eligible as an Associate Member of this Association."

Mr. Smedberg—I would like to inquire whether that clause is intended to include in the class of Associate Members the consulting engineers of the country. If that is the purport of it I think it is unfair.

Mr. Ramsdell—I do not quite understand your inquiry.

Mr. Smedberg—It is whether the consulting engineers of the country are to be refused *active* membership.

Mr. Ramsdell—Not at all.

Mr. Smedberg—It certainly reads in that way.

Mr. Howard—Article X. of the present By-Laws provides that "Any member may, upon conviction of violating any of the laws or rules of the Association, or of conduct unbecoming a gentleman, be suspended for a definite time, or expelled from the Association." At the proper time I wish to move that that article be stricken out entirely. This Association has now been in existence for 16 years, and I do not know of a single instance where it has required an article of that kind. I do not see any benefit to the Association in having such a By-Law. I believe that every member in this Association is supposed to be a gentleman; and I do not think it requires any By-Law to enable us to say that we may at any time suspend a member who shall be guilty of conduct unbecoming a gentleman. I think when such an occasion arises we can deal with the subject without any article of this kind being in the By-Laws.

Mr. Ramsdell—That is in the present By-Laws, and it is copied into the proposed By-Laws with but a slight change; that the expulsion may be by a vote of two-thirds of all the members present, instead of by a majority, as at present.

Mr. Smedberg—As I construe this By-Law relative to active members, it takes in any engineer, or any superintendent of works; but in case he loses his position he ceases to be a member of the Association until he gets a new one.

Mr. Ramsdell—I think that the point of Mr. Smedberg is well taken. It was not intended in that way, but I see the article will bear that construction.

Mr. Smedberg—It affects both classes—constructing engineers and also those who are out of a job.

Mr. Thompson—I understand this is intended to refer only to admissions to membership, and not to changes which may take place afterwards.

Mr. Lansden—At what time will it be proper to move amendments to this report?

The President—When it is properly before the Association.

Mr. Lansden—I do not think that the line of demarkation between active and associate members is sufficiently distinct.

The President—The report at present is not before the house. A motion to adopt the report will bring the matter before the house, and then it will be open for discussion.

Mr. Butterworth—The adoption of a new Constitution is of course an important matter, and it should not be done hastily, or without sufficient consideration. I take it for granted that this committee have had the matter under careful advice, and have been conscientious in their work, and were fully qualified for the work committed to them, and I am satisfied to accept the Constitution as drafted by them. I therefore move that the Constitution and By-Laws as presented by the Committee be adopted.

The President—It may be well to state in this connection that this proposed amendment to the Constitution and By-Laws has come in under Article VI. of the present Constitution, which reads as follows: " Any proposition to amend this Constitution shall be submitted in writing at an annual meeting, seconded by a majority of all the members present; such proposition shall be printed with the proceedings, and shall not be acted upon until the next annual meeting, when, if approved by a majority of all the members of the Association, it shall become a part of this Constitution, and not otherwise." So all that can be done at the present meeting is to have these amendments seconded by a majority of the members present. Then it can be acted upon at the meeting next year. The amendments to the By-Laws can be acted upon and adopted at the present session; but amendments to the Constitution must necessarily lie over until next year.

Mr. Butterworth—Then I will withdraw my motion.

Mr. Howard—Do I understand that amendments to the By-Laws will be in order?

The President—I so understand.

Mr. Howard—Then I move that Article XI. of the proposed By-Laws be stricken out. I understand that the American Association has nothing of the kind in its By-Laws; and I do not think it at all necessary that the Western Association should have any By-Laws relating to the punishment of members for violating its rules, or for conduct unbecoming gentlemen. As I said before, when any member does anything that is seemingly not right, this Association can act in the matter without reference to any By-Law. Such a By-Law is a reflection upon the Association, because it is an intimation that any member can be guilty of conduct unbecoming a gentleman. I see no necessity for having any such By-Law. It is well enough to wait until we come to the bridge before we attempt to get over it.

THE PRESIDENT—Is the motion of Mr. Howard seconded?

MR. MURDOCK—I second the motion.

THE PRESIDENT—It has been moved and seconded that Article XI. of the proposed By-Laws be stricken out. All in favor of that will say, "Aye:" the opposed, "No." The Chair is in doubt.

MR. BOARDMAN—You called for the ayes and nays so quickly that those wishing to give their reasons for voting had no chance to do so. If you will allow me to say it, I differ with Mr. Howard in respect to the necessity or propriety of such a By-Law. I think, in any association of any kind or character, the power which the Association has to select its members is also broad enough to enable it to purge itself of objectionable members; and, if we have a By-Law limiting our choice of members, we ought also to have a By-Law limiting the membership, so that we may protect ourselves in both directions. Whether it ever becomes necessary to use such power or not, I think that the power should exist.

MR. TRACY—I think that By-Law should be left as it is. It is no discredit to any of us if it is never acted upon.

MR. W. MCDONALD—I agree with the gentleman who has just spoken. The occasion could arise when this Association might desire to get rid of one or more of its members, and it might be very difficult to then devise a method of doing so. I think it will be very much better to let this By-Law remain. It certainly does no harm; it is no reflection upon any of us; it is only there for use in case of need.

THE PRESIDENT—Is there any further discussion?

MR. SMEDBERG—I would like to ask whether this article is in the Constitution, or in the By-Laws?

THE PRESIDENT—It is in the By-Laws.

MR. SMEDBERG—The proposed amendment does not alter the status of any who are now members of the Association?

THE PRESIDENT—Not at all. We have under consideration a motion by Mr. Howard that Article XI. of the By-Laws, of the report of the Committee on the Revision of the By-Laws, be stricken out. Are you ready for the question? All in favor of the motion will say "Aye;" contrary minded, "No." The motion is lost.

MR. SMEDBERG—I spoke of this proposed amendment to the article as to the qualifications of members, because I think it is a matter of unfairness to many men who have been for twenty or thirty years engaged as practical gas makers, but are now engaged in the construction or designing of works. I think it is unfair to ostracise that class, as seems to be the direct purpose of that proposed amendment.

THE PRESIDENT—Are you speaking to a motion made by you, or simply making a remark?

MR. SMEDBERG—Simply a remark as to a proposed amendment. I am stating my views.

THE PRESIDENT—You can move any amendment to the report of the Committee.

MR. SMEDBERG—Then I move as an amendment to include consulting engineers in the class eligible for active membership.

THE PRESIDENT—You move that the words "consulting engineers" be added. It would then read: "Only officers, consulting gas engineers and regular employees of gas companies shall be eligible for active membership."

MR. SMEDBERG—That is my motion. It might also be well to put in a clause concerning those who may temporarily be out of employment.

MR. RAMSDELL—It is unnecessary. The amendment does not change that at all.

MR. W. MCDONALD—It seems to me this is rather a knotty problem; but, after all, this Association has full power over its membership, and must retain that power. I question whether "employees of gas companies" does not sufficiently cover consulting engineers. A consulting engineer of a gas company is an employee of that company, and therefore will be eligible to membership under this article as it stands. I think the Association can cover that ground in any special case so that there will be no difficulty if the wording remains as it was.

THE PRESIDENT—I understand the purpose of Mr. Smedberg's amendment to be to cover not only engineers of gas companies, but consulting engineers in general.

MR. W. MCDONALD—But who shall say who is a consulting engineer? That is for the Association to decide finally.

MR. SHELTON—I think that "such person or persons so identified with the gas industry as to be eligible for active membership in the judgment of the Directors of the Association" would cover it.

THE PRESIDENT—We are discussing Mr. Smedberg's motion just now.

MR. SHELTON—I intend this to cover his motion. I thought Mr. McDonald disagreed as to the exact wording; and I was simply suggesting that instead of the arbitrary wording "consulting engineers" (which might mean hydraulic engineers), a clause reading "persons so identified with the gas business as to be eligible to active membership in the judgment of the Directors of the Association" might cover the entire ground,

MR. RAMSDELL—I might say this was considered and discussed by the Committee at our first meeting. In fact, at two meetings this matter was carefully considered, and that very point was weighed by the Committee. It was thought the wording presented by the Committee would cover it, inasmuch as it defines that whoever is admitted to active membership must in some way be connected with the gas business. This wording was thought to cover the point in such a way that any gas man or consulting gas engineer applying for membership would, under this rule, be admitted.

THE PRESIDENT—Is there any further discussion on Mr. Smedberg's motion?

MR. LANSDEN—It strikes me the definition of the word "employee" is hardly sufficient. It seems to me, as it now reads, that a man who knows nothing of the gas business, but who happens to be an employee of a gas company, could come in as an active member. We have as employees men who drive our wagons about the streets. Would they be eligible to membership? It strikes me that "employee" is hardly definite enough. I know that the practice has been, under the old By-Laws, to take in any man proposed for membership, whether he was actually engaged in the gas business or not, because we generally know whether he had ever been connected with a gas company, or was properly to be considered a gas man. Whether he was actually employed at the time or not, we never thought of ruling him out. I know that gentlemen of Mr. Smedberg's standing have always been accepted by the Association as active members—they were understood to be gas men; they were conversant with the manufacture of gas. I do not know how to offer any amendment to this, but it seems to me it would be hardly safe to adopt that just now.

MR. MONTGOMERY—I would suggest that a man who is selling gas stoves or driving a wagon would have to be elected first.

MR. LANSDEN—But any employee might claim the right to election to membership.

THE PRESIDENT—As I understand the business before the house now, it is Mr. Smedberg's motion to introduce the words "consulting engineers" in that section. Is there any further discussion?

MR. JENKINS—I think a man is not much of a consulting gas engineer unless he is employed by one or two companies, when he becomes eligible as an "employee."

MR. EGNER—Possibly it might ease the minds of some of the members if these words were added: "But this section shall not be construed to affect the standing of any member now on the active list."

THE PRESIDENT—Do you offer that as an amendment?

MR. EGNER—I do not like to offer it as anything more than a suggestion.

MR. SMEDBERG—This is a matter which does not concern me one particle. I have no personal motive in the suggestion I have made. You cannot pass a retroactive law and you do not propose to do it, so that Mr. Egner is entirely at sea in what he says. I am referring to the future. It has nothing to do with my own personal circumstances, or position, or anything of the sort. It is merely with regard to future applications.

MR. EGNER—May I offer to amend the amendment?

THE PRESIDENT—Yes.

MR. EGNER—Then I move that the section as read shall stand, but that these words be added: "But that this section shall not be construed as affecting the standing of any member now on the active list."

MR. BOARDMAN—That is hardly necessary, because it could not affect it anyway.

MR. EGNER—Then I will withdraw it.

MR. TRACY—I move that the consideration of these By-Laws be left over until next year.

THE PRESIDENT—The gentleman is out of order. The question before the house is on Mr. Smedberg's motion to insert the words "consulting engineers" in that clause. Until that motion is acted upon we cannot proceed to anything else.

MR. RAMSDELL—Mr. Smedberg's motion provides that the words "consulting engineer" be added to Section 1 of Article I., so that it will then read as follows: "Only officers, consulting gas engineers and regular employees of gas companies shall be eligible for active membership."

THE PRESIDENT—All in favor of the amendment as read will say "Aye;" contrary, "No." The motion seems to be lost. It is lost. The section stands as it is.

MR. JENKINS—Now, I move that the report of the Committee be adopted.

THE PRESIDENT—That is hardly the way. Article VI. provides that "Any proposition to amend this Constitution shall be submitted in writing at an annual meeting, seconded by a majority of all the members present; such proposition shall be printed with the proceedings, and shall not be acted upon until the next annual meeting, when, if approved by a majority of all the members of the Association, it shall become a part of this Constitution, and not otherwise."

MR. JENKINS—Then I will withdraw my motion and move that we second the report.

MR. LANSDEN—A year hence can amendments be made?

THE PRESIDENT—I so understand it.

MR. LANSDEN—That is, twelve months from now any amendment may be offered on the same condition as now?

THE PRESIDENT—That is the way I understand it.

MR. COWDERY—Does this motion cover the entire report of the Committee? Does it cover the Constitution, or the By-Laws, or both?

THE PRESIDENT—We are considering the Constitution just at present. We can vote on the By-Laws at this meeting. Mr. Jenkins moves that the report of the Committee upon the amended Constitution be seconded. Are you ready for the question? As many as favor the motion will say "Aye;" opposed, "No." It is carried.

Mr. W. McDonald—I now move that the report of the Committee on By-Laws be adopted.

The President—The Constitution provides that amendments to the By-Laws must lie over for one day.

Mr. Jenkins—I move that we suspend Section 1 of Article XIII., requiring proposed amendments to the By-Laws to lie over for one day. Then these amendments can be taken up at once.

Mr. W. McDonald—I withdraw my motion and second the motion of Mr. Jenkins.

The President—Mr. Jenkins moves we suspend Section 1 of Article XIII. That will enable us to act on the new By-Laws at the meeting to-day.

Mr. A. S. Miller—I rise to a point of order. Suppose we do adopt these amendments to the By-Laws. If the new Constitution is not in operation, what is the use of the new By-Laws?

Mr. Thompson—As I understand it, the new By-Laws cannot go into effect until we adopt the new Constitution.

Mr. Lansden—I move, as an amendment to Mr. Jenkins' motion, that we second the By-Laws, as we have the Constitution, and that they then lie over until next year.

The President—Do you move that as an amendment to Mr. Jenkins' motion?

Mr. Lansden—Yes.

Mr. Jenkins—May I ask a question of the Chair? Do you rule that we can take up these By-Laws now, if we suspend Section 1 of Article XIII., and adopt them section by section?

The President—I think we can.

Mr. Jenkins—I made my motion so the matter could come up properly for the Association to act upon it. If my motion is carried it simply opens up this question. It brings the By-Laws before you for your action, so that if you wish to act on them to-day you can do so. You could do so without such motions, if we had a meeting to-morrow. We cannot do so at this session without suspending that section. If we had our regular sessions we might adopt these By-Laws to-morrow, and adopt the Constitution next year if we so desired. I really do not think it is a proper thing to do, and the object of my motion is simply to get the matter before the house.

Mr. Howard—At present we are acting under our old Constitution and By-Laws?

The President—Yes.

Mr. Howard—You have laid over the new Constitution until next year. Now you want to adopt new By-Laws without having acted on that Constitution. I think we cannot do that. You cannot have those new By-Laws under the old Constitution—you want them under the new Constitution—therefore the By-Laws must go over until next year, or until you adopt the Constitution.

Mr. W. McDonald—I do not think Mr. Howard is right in that. I think we can adopt the new By-Laws. This Association is a power in itself, and it can do what it pleases to make up its mind about.

Mr. Jenkins—All I want is a vote on the question; and in order to bring it before the house I will accept Mr. Lansden's amendment.

The President—Will Mr. Lansden state his amendment again?

Mr. Lansden—My amendment was to the effect that we second these By-Laws as we did the Constitution. We cannot act on the amendments to the By-Laws until to-morrow.

The President—If Mr. Jenkins' motion prevails, and we suspend that By-Law, we can act on the amendments tó the By-Laws at once.

Mr. Lansden—I will withdraw my amendment if he withdraws his motion.

Mr. Beale—I question whether it is worth while to take up much more time about this. I want to say, for the education of the members who have just come to town, that it is extremely dangerous to do anything here without a good constitution. I think we had better have the old and the new together, and then we will be able to get through the Chicago weather without very much danger—By-Laws and all—until another year.

The President—Does Mr. Jenkins withdraw his motion?

Mr. Jenkins—My idea was simply to get a vote on this question. I withdrew my original motion, and now Mr. Lansden has withdrawn his amendment.

Mr. Lansden—As I understand it, that leaves it in such a shape that we can second the By-Laws?

The President—Yes; and it puts the By-Laws in the same shape as the Constitution.

Mr. Lansden—Then I move that we second the By-Laws, as we did the Constitution, and let them lie over until next year.

The President—Mr. Lansden moves that the report of the Committee on By-Laws be seconded, and that they lie over under the rules until next year.

Mr. Jenkins—It is understood that these By-Laws can be amended at the next annual meeting?

The President—Yes; but then they will have to lie over another year. All in favor of Mr. Lansden's motion will say, "Aye;" opposed, "No." It is carried. The Constitution and By-Laws are seconded and will lie over until next year.

ELECTION OF NEW MEMBERS.

Mr. J. W. Dunbar, from the committee appointed to examine and report on applications for membership, recommended the election of the following persons:

Active.

Averill, G. M., Cedar Rapids, Ia.
Cowdery, R. E., Topeka, Kas.
Dixon, J. A., East Orange, N. J.
Dunbar, C. H., Philadelphia, Pa.
Dunlevy, H. H., Wheeling, W. Va.
Finnegan, A., St. Louis, Mo.
Frost, W. H., Fort Scott, Kas.
Greenough, M. S., Cleveland, O.
Hopper, W. H., Philadelphia, Pa.
Malin, H. A., Joplin, Mo.
Miller, T. D., Dallas, Tex.
Rathell, W. S., Cairo, Ills.
Thwing, O. O., St. Louis, Mo.
Woodward, R., Peru, Ind.

Associate.

Guilford, A. J., Chicago, Ills.
Keeler, H. E., Chicago, Ills.
Payne, F. H., Erie, Pa.
Van Wie, E. G., Chicago, Ills,
Watson, W. P., New York City.
Witherden, G. M., Erie, Pa.

The President—You have heard the report of the committee. What is your pleasure?

Mr. Lansden—I move that the Secretary be instructed to cast the ballot of the Association for the election of the members recommended by the committee. (Carried.)

The Secretary—I cast the ballot of the Association for the election of the gentlemen whose names have just been presented for membership in this Association.

INTRODUCING THE NEW MEMBERS.

Mr. Jenkins—The committee on the introduction of new members would like to have those whose names have been called rise in their places. I take pleasure in introducing to this Association these, our new members, and express the hope that they come in here with us with the full determination of being "one of us," and of getting all the benefits from such membership they possibly can.

REPORT OF COMMITTEE ON PRESIDENT'S ADDRESS.

Mr. Walton Clark read the following report:

To the Western Gas Association—Gentlemen: Your Committee on President's Address for the session of 1893 report as follows:

If President Chollar has not been governed by precedent in the preparation of his address, it is obviously to the advantage of the Association. In that he has left technical matters to be presented by the readers of papers and discussed by you, devoting the time given to the Presidential address to calling your attention to the importance of Association work, and to your duties as members of the Western Association, he has made a departure from time-honored practice, upon which we congratulate him and you.

Though President Chollar assumes that the days of austerity in the gas office are passed, we feel that all within sound of his voice may profit by a consideration of his characteristic account of the condition of affairs a generation ago, and, carrying home with us the spirit of his address, apply the lesson that may be therein learned to the conduct of our own offices, with advantage to the relations existing between us and our consumers.

We would particularly emphasize to the individual members of the Association the importance of the idea covered by the President's apt quotation from the Scottish bard:

"A chiel's amang ye takin' notes,
And, faith, he'll prent it."

If, simply for the sake of our hearers, we will not make a strenuous effort to write and talk to the point, stating as facts only what we *know* to be facts, the knowledge that our statements will appear in print, and may later arise to vex us, should have the effect of making us careful and conservative.

We particularly commend to your consideration what your President has said to you of the value of scientific education as an aid to success in our business in this day of hustling competition. Still, as the President has said, a period in the technical school is not necessary to success in gas engineering. Care, thought and determination to succeed are the characteristics that will gain an education for the ambitious young man, even while working for his daily bread.

One of the matters of immediate importance in connection with the technical branch of our industry is the alleged destructive action of electric currents on mains and services. We recommend that the President be authorized to appoint a small committee to have this matter in hand the coming year and report at our next meeting.

What your President has had to say in connection with the utilization of gas and the insuring that it shall be burned to the greatest possible efficiency, while not new, is always pertinent. We hope, with the President, that the time is at hand when we will all give this question of the proper combustion of gas for the development of light the attention its importance demands.

We apprehend that there may be some misunderstanding of the President's meaning in that part of the address referring to the relative importance of the producing half and the selling half of the business. We feel sure that the President does not desire to belittle the value of discussions upon commercial and business topics in the Association. It is doubtless his idea, and we believe the correct idea, that purely technical questions will receive a freer and wider discussion than will questions relating to dollars and cents, or to the conduct of an office; and that, therefore, our time can be devoted with greater advantage to the discussion of matters purely technical.

In closing, we quote what seems to us the keynote of the President's address, recommending it to you, as more careful consideration of the address has recommended it to us, as an injunction to be remembered and put into practice whenever we have to do with matters relating to the Western Gas Association:

"Let us, therefore, strive to promote its usefulness, maintain its efficiency, and uphold its dignity, and by so doing advance our own interests and enhance the value of the property that we represent."

Respectfully submitted,
WALTON CLARK,
JAMES R. SMEDBERG,
C. R. FABEN, JR.,
Committee.

On motion of Mr. Boardman the report was accepted and its recommendations adopted.

THE PRESIDENT—I will announce the Committee recommended by this report at the next session. We will now listen to a paper by Mr. James Ferrier, of Columbus, Ga., entitled

RESIDUALS: IDEAS CONCERNING THEM SUGGESTED BY THE OUTLOOK.

In introducing the subject of residuals, I hope I shall not be considered encroaching too much on the domain of our President if I glance briefly at the present status of the gas industry. It has at the present time to deal with two assailants, either of them calculated to cause gas companies to search for the ways and means of reducing the cost of gas. I refer to electric lighting and, in some localities, to the State or municipal government. As regards electric lighting, it is a fact that it is a formidable competitor, and although it has, up to the present, caused no actual decrease in the output of existing companies, it has, to some extent, checked the expansion of the gas industry. It might be well also for gas men to contemplate the fact that many bright minds are occupied in the attempt to solve the problem of directly transforming the undulation of heat into the undulation of electricity, and that its solution in the near future is, at least, a possibility. In the days when gas had no such competitor, the present attitude of certain State and municipal governments might have been intelligible; as it is, their wanton attacks have, in some instances, caused serious losses to investors, who had expected that at least ordinary business ethics would be recognized by those bodies in their dealings with gas companies.

While it is beyond doubt that electricity is one of the great factors of modern progress, it has escaped many that another feature of that progress is a departure from the present crude and wasteful methods of using fuel. It is difficult indeed to calculate the number of valuable chemical combinations—the amount of "energy of position"—which is wasted by throwing coal into a grate or furnace. That this has so long continued suggests "something wrong" on the part of those whose peculiar province it is to foster and promote such a departure—in short, of gas companies. An earlier recognition of the fact that this is their true province might have saved many gas companies from costly experiments in electric lighting, undertaken with the idea that *light* was their sole means of subsistence.

Said the late Mr. Page, at our meeting in Cincinnati, four years ago: "Wait until gas can be put into holder for nothing, then—fuel gas." In these four years have we made an approach towards this ideal? While the use of gas as fuel has been successfully promoted, it must be admitted that the advance made towards putting it into the holder for nothing has been disappointing. Depression has been, and still is, the ruling feature in the residual market, and that in times when it is totally unwarranted by the general state of trade. Much of the depression in prices, notably that in tar, has been laid at the door of combinations among firms and companies handling the product. If it be true that such combinations have been able to dictate prices, the fact cannot be considered highly creditable to the gas industry, employing, as it does, hundreds of millions of capital in this country. When we consider another residual, ammonia, we find still less to boast of. I am not aware how many companies work up their ammoniacal liquor, but I know the number is small, although the necessary apparatus is not costly, and great skill is not required. A larger number concentrate their liquor and often sell it at ridiculously low prices, while their name is legion who throw it away.

In searching for the causes of this state of affairs the conclusion is forced upon us that the scattered and disjointed action of gas companies must be held largely accountable. Gas men have not been wanting in individual energy, but concerted effort there has been none. To illustrate: I have known of two gas companies, not 100 miles apart, selling their tar to the same firm, and that firm paying to one just two and one-half times the price it paid to the other. I have known of coke being sold in one city at from 12 to 15 cents per bushel, while in another some 200 miles distant it was selling at 5 cents. There existed no similar difference in the respective prices of coal in those cities. Some instances, cited by Mr. Egner at the last meeting of the American Gas Light Association, show, with peculiar force, the groping of gas companies with regard to the disposal of their ammonia.

Where is the remedy? This has been the question asked as often as the subject has been mooted, but the inquiry does not seem to have proceeded far. Instruction may be derived from a study of the methods adopted by a kindred industry to our own—petroleum. In it we find companies, backed with the necessary capital, making use of the latest revelation of science in the treatment of their product. The various constituents are separated, and they do not stop there; those constituents are placed on the market, and their uses duly set forth and advertised. (It may be here pertinently remarked that it was with truth said, at a meeting of the American Association, that the State of Ohio alone had use for all the ammonia made in the United States.) Since petroleum was thus treated, the prime commodity, lamp oil, has been greatly reduced in price, and it is beyond question that, were coal products similarly dealt with, while gas companies would probably be gainers, the greatest beneficiary would be the gas consumer.

I may anticipate the objection that will be made to this suggestion—that the magnitude of the project precludes its consideration; but I have another suggestion which is not open to such objection, and perhaps, on the principle that we ought to begin at the lowest rung of the ladder, it deserves to be first considered. It is within the power of gas companies carbonizing as little as from 5 to 20 tons of coal per diem, and within a radius of, say, 200 miles, to select a good railroad center and there establish a plant for the working up of ammoniacal liquor. The capital required would be small, and all could have an interest in it. It could be under the supervision of the gas company at that point, and all companies interested in it could be allowed the net amount realized for the ammonia less the freight paid on the liquor. Even if companies could not be persuaded to enter into such a project, the establishment of an ammonia works and the collection of liquor by a well-situated gas company seems feasible. The start made with ammonia might in time be extended to other residuals, and, in any event, the central company would be a bureau of information, which would to some extent prevent the inequalities in prices which I have cited. The solution of the tar question, by using it as fuel in place of coke, would be facilitated, and the Sibyl's remedy for non-appreciation might be applied with similar success.

However much I may be differed from regarding detail, I venture to say that most will agree with me, that in the formation of such *nuclei* lies the solution of the residuals question, and probably of other questions now affecting the gas industry.

DISCUSSION.

THE PRESIDENT—You have listened to a very interesting paper, on an important subject. Discussion is now in order, and we shall be glad to hear from everybody on that point.

MR. ODIORNE—I want to ask how it is that some companies manage to get so much more for their coal tar than others can get. I would like to know the secret of it.

MR. FERRIER—I think I have answered that in the paper—that it is simply because of the fact that there is no confederation among the companies. One company does not know what another is getting, as there is no means of disseminating the necessary information as to what any particular company is receiving. I think that is the cause.

MR. ODIORNE—I am inclined to think that those high prices are prices which have held over for a year or two back; that they are paid to companies who have contracts running for two or three years, and that no new contracts are now being made at those high prices.

Mr. Ferrier—In the case which I have cited that was not the cause.

Mr. Odiorne—We have tried pretty thoroughly to get good prices, but failed.

Mr. Jenkins—I think in the last year, with at least one-half of the gas companies in the South, there has been a variation of 75 per cent. in the price of coal tar.

Mr. Odiorne—On contracts now being made?

Mr. Jenkins—Yes. I refer to the prices for 1893.

Mr. Odiorne—Can you tell what the highest price now paid is?

Mr. Jenkins—The prices run all the way from $2 and $2.50 to $3 and $3.50 per barrel.

The President—Can we hear something from Mr. Faben on the subject of residuals?

Mr. Faben—I do not know that I can offer anything this morning on this subject, but I would like to hear from Mr. Butterworth.

The President—Mr. Butterworth is called for.

Mr. Butterworth—At the last meeting of the Ohio Gas Light Association a committee was appointed to endeavor to unite the gas companies of the State in an effort to co-operate in securing better prices for tar, by establishing, by purchase or by erection, tar distilleries to be operated by the companies, either as such or by individuals, who would really represent the companies. Under the laws of Ohio one corporation cannot hold stock in another; so that the gas companies as such cannot form a stock company to work up their own tar; but a few individuals can do so, who would still really represent the companies. That committee (of which I am chairman) are now trying to carry out the instructions of the Association in this respect. They have found a good many difficulties, chief among which is the fact that the larger companies of the State have already contracted for their tar for a term of years, and they hold the key to the situation. The smaller companies cannot do much by themselves. We are now getting expressions of opinion from all the gas companies of the State, and when we get them we will come together and talk the subject over. At present matters are in a crude and unfinished condition.

The President—What about ammonia?

Mr. Butterworth—Our instructions contained nothing with reference to ammonia. There is no effort of that kind being made with respect to ammonia.

Mr. Ramsdell—The price of tar is largely controlled by its location. We get less for our tar in Ohio than is paid in our works elsewhere, and we get the highest price where we can create a local demand for it. We are still getting very good prices in two or three of our companies, but a good deal of that tar is being used locally for sidewalks and for work of that character. I think that any market of a local character that we can create will conspire to increase our prices more satisfactorily than anything else we can do, because that keeps it out of the hands of the combination.

Mr. Penn—I think it is a good deal as Mr. Ferrier says. A couple of weeks ago I asked a friend what he was getting for tar, and he said $3, but it was under a contract made a year or two ago. The best price that I could get from the same parties was $2. We live only about 25 miles apart—I am just as near the factory as he is—and I do not know why I should get less than he does, unless it is that the President of the works wants to boycott me. I am satisfied they are giving him a better price for tar than they are offering us. I think if there was a coöperation among gas companies we might be able to get better prices. I asked this same gentleman if he was willing to go with us into this coöperation that Mr. Butterworth speaks about, and he said he was not in favor of going into the combination, which was all he had to say about it.

The President—Can we not hear from Mr. Somerville on this subject?

Mr. Somerville—I wish the author of the paper had said a little more upon this part of his subject. He says: "It might be well also for gas men to contemplate the fact that many bright minds are occupied in the attempt to solve the problem of directly transforming the undulation of heat into the undulation of electricity, and that its solution in the near future is, at least, a possibility." I thought that gas men had a good many facts to contemplate already, and I wondered what in the world this other fact was which was going to be sprung upon us. I would like the gentleman to give us a little more insight into it if he can.

Mr. Ferrier—As regards electricity being an undulation, of course that is a matter that we cannot go into here, but the fact seems to have been established by the experiments of the German physicist Hertz. As regards the transformation of undulations of heat into undulations of electricity, I may say it is well known to most electricians in this and other countries that they can transform electricity directly into heat, but they have as yet failed to directly transform heat into electricity; and that is the great subject of inquiry among electricians at the present day. I wish to say a word in reply to Mr. Ramsdell's remark about a local demand for tar. My experience is that it is oftener pitch than tar which is required. In that case they take the tar and boil it down to the consistency they require, and that means simply a sacrifice of the lighter oils. I think by erecting distilleries we could give them the pitch even cheaper, and still get a fair price for tar.

On motion of Mr. Lansden, the thanks of the Association were voted to Mr. Ferrier for his paper.

The Association then took a recess until 2 o'clock P.M.

FIRST DAY—AFTERNOON SESSION.

The Association met at 2 P.M.

ELECTION OF OFFICERS.

Mr. Somerville, Chairman of the Committee on Nomination of Officers, presented the following nominations:

President—E. H. Jenkins, Columbus, Ga.

First Vice-President—I. C. Baxter, Detroit, Mich.

Second Vice-President—Wm. H. Odiorne, Springfield, Ills.

Secretary and Treasurer—A. W. Littleton, Quincy, Ills.

Board of Directors—R. Spencer, Burlington, Ia.; J. W. Stratton, Valparaiso, Ind.; Robert F. Fitz, Elgin, Ills.; James R. Smedberg, Chicago, Ills.; Wm. McDonald, Chicago, Ills.; James Ferrier, Columbus, Ga.; George T. Thompson, St. Louis, Mo.; Benjamin A. Ward, Michigan City, Ind.; B. E. Chollar, St. Louis, Mo.

JAS. SOMERVILLE,
GEO. G. RAMSDELL,
FREDERIC EGNER,
T. G. LANSDEN,
J. B. HOWARD,
Committee.

THE PRESIDENT—You have heard the report of the committee; what is your pleasure?

MR. RAMSDELL—I move that Mr. Somerville, the chairman of the committee, cast the ballot of the Association for the election of the persons named.

The motion prevailed, Mr. Somerville cast the ballot of the Association as directed, and the nominees were declared duly elected officers of the Association for the ensuing year.

PLACE OF NEXT MEETING.

MR. COWDERY—The Committee on the Place of Next Meeting met this morning and carefully considered the matter. In the absence of any invitation to the Association to come to any particular place, they were at liberty to express their opinions freely as to where the Association ought to go. Some thought that the Association ought to be taken to some southern city; on the other hand, it was thought possibly that might seem a little too far to some of the members. In that connection, Nashville, Tenn., was mentioned; and by others it was thought quite desirable to have the Association go to Kansas City. Another selection was Cleveland, O. After carefully considering these three places, the committee decided to report to the Association that in their opinion Cleveland, O., should be selected as the next place of meeting.

The President—You have heard the report of the committee. Are there any remarks or suggestions?

Mr. Lansden—With all due deference to the report of the committee, I wish to submit a name to the Association. I am somewhat opposed to going to the extreme ends of our district; and I would move, as an amendment to the report, that the Association meet next year in Cincinnati, O.

The President—The question before you is on the adoption of the report of the committee as presented.

Mr. Lansden—I withdraw my motion.

The President—After the report has been acted upon—if rejected—you can then come in. Are there any further remarks?

Mr. Egner—I move the report of the committee be accepted.

Mr. Somerville—I second the motion.

The President—It is moved and seconded that the report of the committee, and their recommendation, be accepted.

Mr. Ramsdell—Does not that bind us to Cleveland, if the report is accepted?

The President—If it is accepted it binds us to Cleveland. If not accepted it leaves the question open; but we cannot entertain another motion until after this report of the committee is acted upon.

Mr. Somerville—I think Cincinnati is a very good place, but as our committee have reported in favor of Cleveland, I do not see why we should not go there. It is a beautiful place, and we have never been there. I shall vote for the report of the committee.

The President—It is necessary to act upon the report before we can entertain any other motion. Is there any further discussion? All in favor of adopting the report of the committee will say, "Aye;" otherwise-minded, "No." The motion is carried. Is the Committee on Memorials ready to report?

Mr. Ramsdell—While waiting for that committee I would like to make a motion. We have all heard with sincere sorrow of the loss of the wife of one of our members. The news reached here just about the time we reached this place. I move the Secretary be instructed to send a telegraphic message to Mr. J. T. Lynn, expressing our sincere sympathy with him in his great affliction.

Mr. Jenkins—I second the motion, and suggest that the vote be taken by rising.

The President—The members will please rise. It is unanimously carried.

Mr. Somerville—It has been the custom heretofore for a newly-elected President to say something to show whether he will accept the presidency or not. We do not know whether our newly-elected President will accept the office, and we would like to hear from him.

The President—Mr. Jenkins, some doubt has been expressed as to whether you will accept the presidency. Please set the doubt at rest.

Mr. Jenkins (President elect)—It has always been the custom to ask the President elect beforehand whether or not he would have something to say. That was not asked me, and so I did not say anything. But I do want to say to you, Mr. President and members of the Association, that I deeply appreciate the honor conferred upon me. Had I known, two years ago, the duties and responsibilities devolving upon the President of the Western Gas Association as well as I now know them, I think I should have declined the promotion. My friends at that time saw fit to put me in the line of promotion, and I had nothing else to do but yield to their wishes. Coming as I do from one of the smallest companies in this Association, and knowing as I do that there are in the Association many who are more capable of filling the office and better fitted to discharge its duties than I am, you will nevertheless understand, I thoroughly and gratefully appreciate this honor. I ask each and every one of you to assist me in my effort to satisfactorily perform the duties of the office. (Applause.)

The President—Neither Mr. Baxter nor Mr. Odiorne, our Vice-Presidents elect, seem to be present, so we cannot hear from them.

Mr. Lansden—I wish to say, as a member of the Nominating Committee, that I had very hard work in inducing the Committee to nominate our Secretary for re-election, and we would like to know if he will accept the office.

The President—We will hear from Mr. Littleton.

Mr. Littleton—Gentlemen, I am very much obliged to you for the honor.

SPECIAL COMMITTEE ON ACTION OF ELECTRIC CURRENTS ON GAS PIPES.

The President—The Committee on President's Address recommended the appointment of a committee to collect data with regard to the action of electric currents on services. I will appoint on that Committee Messrs. Geo. Treadway Thompson, St. Louis, Mo., Alten S. Miller, Chicago, Ills., and James Somerville, Indianapolis, Ind. If there is no other business in order we will now listen to the paper by Mr. Geo. Treadway Thompson, of St. Louis, Mo., on

WRINKLES.

Some two years ago one of our technical journals opened an interesting department devoted to contributed hints on details in gas manufacture, and not a few valuable suggestions were in it brought to our fraternal knowledge. On corresponding lines, I now present a few more, of similarly diversified application, in the assurance that almost every member here present has, in the course of his experience, evolved certain "unpatented patents" fitted to his local conditions, and in the hope that this paper may induce a reminiscent mood among us which shall result in a genuine experience meeting, the recollections of which may be stored in the wrinkles of our brains,

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and perhaps aid on some future occasion in driving gathering wrinkles from our brows.

Adjustable Mouthpiece Support.—In the accompanying sketches, Figs. 3 and 4, Plate I., show a simple form of adjustable support for mouthpieces, or furnace doors, which has commended itself to its users by nearly two years of service. It consists of three parts: First, a 1¼-inch pipe, open at its upper end, and flattened below to attach to a shoe of any convenient form—or in a stage floor retort house, to a beam or plate; second, a T-piece formed by welding a 1-inch threaded bolt to a 2 x ½ x 12-inch head, properly bent; third, a 1-inch nut. The support may be easily made by any good blacksmith, is inexpensive—for it may be formed from scraps otherwise useless—and is readily placed and adjusted.

Sight-feed for Oil Retorts.—The sight-feed, for oil when used in a retort process (Figs. 9 and 10, Plate II.), is placed on the line of vertical pipe, just before it enters the mouthpiece. There is a top and a bottom piece of brass, and a brass bushing which screws into the former to give direction to the stream. Each of these pieces is recessed to receive a leather ring, against which the edges of a glass cylinder bear, the whole being drawn together with four bolts to secure tightness throughout.

Adjustable Safety Overflow for Hydraulic Mains.—In the design of many forms of tar-gates for hydraulic mains which are in use, one or the other of two essential features has been overlooked, namely, that the take-off should be from the lowest point on the main, and that means should be provided to maintain a pressure on the overflow equal with that within the main. The first of these precautions ensures the removal of the heaviest tars, and so aids in keeping the main clean and in minimizing the weight of the seal, and the second prevents the blowing-out or siphoning of the liquid in case of back pressure. Most of the forms of overflow designed to accomplish these ends are comparatively expensive and must be made expressly for the main to which they are to be attached. The form shown in Figs. 1 and 2, Plate I., however, requires no especially skilled labor for its construction, may be applied to any hydraulic, and is easily adjusted by the swinging arm. The fittings it requires are these: ¾-inch—three street ells, one plain ell, one tee, one plug, one right and left coupling, one short and two long nipples, and one short piece of pipe; 2-inch—one 2 x ¾-inch reducer, two tees, one cross, three plugs, two short nipples, one short piece of pipe, and one long piece of pipe to reach the seal-pot. A 2-inch and a ¾-inch tap or valve may be added if desired.

In putting together, the vertical joints should be left just loose enough to move through the required range of adjustment; all other joints should be screwed home.

Making Connections on Vacuum Mains.—Winkle No. 4 deals with methods rather than means. It is the practice of making connections

"WRINKLES."

PLATE I.

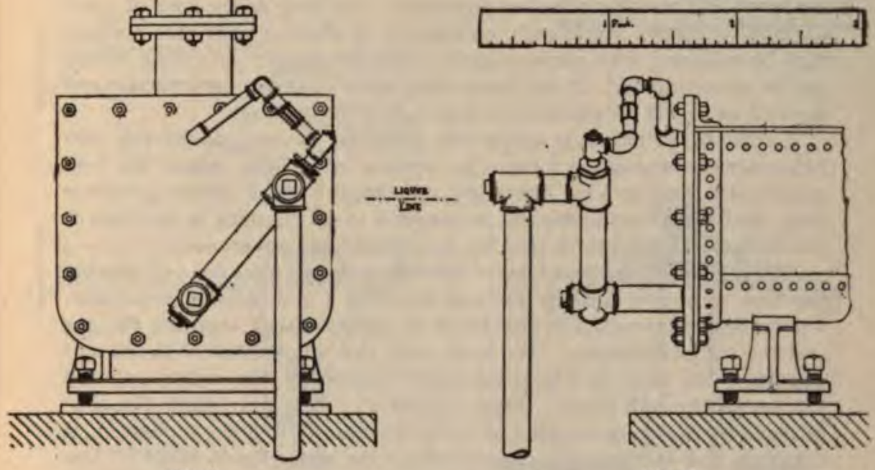


FIG. I. FIG. II.

ADJUSTABLE SAFETY HYDRAULIC-MAIN OVERFLOW.

ADJUSTABLE MOUTHPIECE SUPPORT.

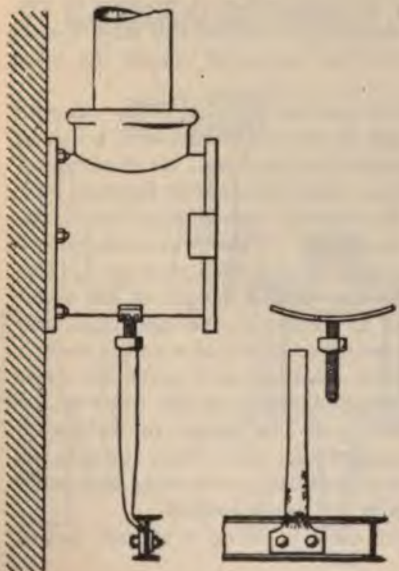


FIG. III. FIG. IV.

PUMPING DEVICE FOR LIQUOR CISTERNS.

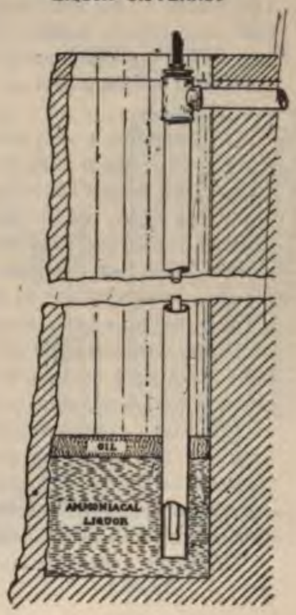


FIG. V.

Geo. T. Thompson. Del

[illegible] that this method [illegible] danger of [illegible] opening.

[illegible] having two [illegible] of piping, where the [illegible] by a steam governor [illegible] all changes in the rate of [illegible] gas governor.

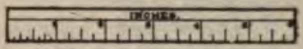
Locating a Water Leak in a Multitubular Condenser.—Probably the most annoying [illegible] a multitubular condenser [illegible] plates which separate the gas and the water [illegible] had this experience with an apparatus [illegible] the water surrounds the tubes and the gas passes through them. Figs. 12 and 13, Plate III., show the condenser (the water [illegible] compartments, separated at bottom), and [illegible] the water fluids follow. The leak [illegible] the weakened ammoniacal product, and [illegible] considerable as to necessitate the waste of all the condenser [illegible]. The bolted plates covering the compartments are [illegible] that it is necessary to raise two of them to reach any one [illegible] compartment, and this involves the removal of 158 bolts. The leak might have been in a division plate at either end, in a [illegible] sheet, or in the tubes themselves in any one of the [illegible]. It was desirable to locate and stop it with the least possible loss of time, which also meant of course the least cost and loss.

At this point a very simple method was employed. A line of pipe leading to a drain [illegible] along the side of the apparatus, with a valved connection to the bottom of each water compartment, for drawing off deposited mud. This attachment was made to assist in the following manner: All mud was first drawn off, then all valves were closed, including that on the main line to the drain. Water was turned on to fill the compartments to the normal height, and then shut off. Then a piece of pipe of a length equal to the vertical height of the water divisions was attached by a street ell to a cross on the mud pipe, and held by a rope so that it could be swung on the L as a center from a vertical to a horizontal position. After standing over night, the water in the leaky compartment had all escaped down to the level of the break. The swinging pipe was then used as a gauge, the valves on the several water divisions being opened one at a time, showing all compartments full but one, and thus infallibly indicating the leaky section, as well as the height at which the break existed.

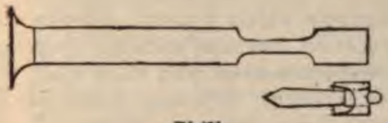
The same principle has since been used in filling a station meter,

"WRINKLES;"

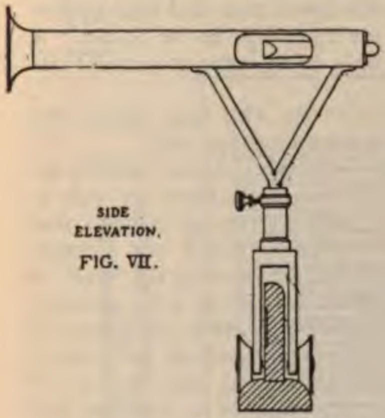
PLATE II.



SCALE.



PLAN.
FIG. VI.



SIDE ELEVATION.
FIG. VII.

BAR PHOTOMETER SCREEN.

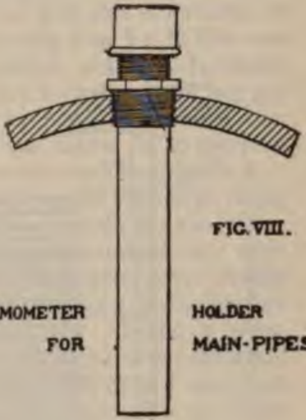


FIG. VIII.

THERMOMETER HOLDER
FOR MAIN-PIPES.

PENCIL HOLDER
FOR
RECORDING GAUGES.

SIGHT FEED
FOR
OIL RETORTS.

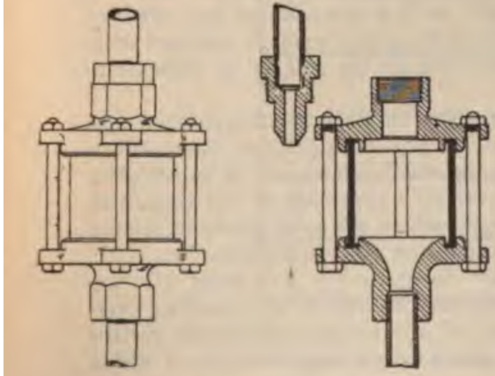


FIG. X.

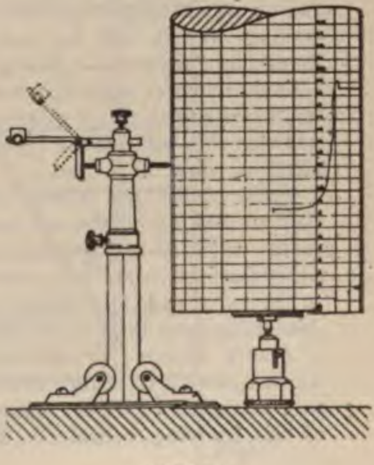


FIG. XI.

Geo. F. Thompson, Del.

to show the quantity of water contained until it reached the height of the glass gauge.

Thermometer Case for Main Pipes.—The pipe thermometer holder shown in Fig. 8, Plate II., is comparatively widely known; but the fact that many small works are wholly without means of knowing when their condensers are doing their duty and when overdoing it, or what proportion of their gas unaccounted for is due to shrinkage between station and consumer's meters, prompts me to risk reintroducing it. A convenient size may be made by cutting a thread 2 inches long on one end of a ¾ inch pipe about 8 inches in length, running a 1 x ¾ inch bushing upon this, welding a plug in the lower end, and then screwing the bushing into a 1 inch hole in the main pipe to be tested. A cap is loosely screwed on the top, its only office being to prevent circulation of air within the holder.

A cheap and convenient thermometer to use with this case is the paper cylinder "Dairy" form, costing from 20 to 30 cents.

Quieting a Groaning Station Meter.—A crying station meter is far from a perennial joy, though it may become such when its wail is stilled. We underwent an experience with a groaning meter a few months since, which is instructive in retrospect, though not pleasant while it lasted. The meter began loudly proclaiming the want of lubricant on its journals, and we succeeded in quieting it by lowering the water line to about the center of the case, covering the surface of the water with heavy oil, and allowing this to permeate all portions of the metric anatomy. But this answered only for a time, for we, of course, went back to the proper water line as soon as possible, and then the moaning recommenced.

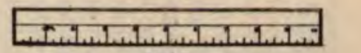
The remedy was found in pumping into the case below the water line a quantity of soft soap in solution in hot water. All the liquid in the meter was thus converted into a tolerably good lubricant, and the wailing ceased, and has not again been heard. The soap is that known as Fairbanks' "No. 3," "crude soap," or "oly." Any soft soap will answer as well, however. At first the solution may discolor the water in the gauge glasses, but if the gauge water is changed once or twice this will not be repeated; nor are the gauges so difficult to clean as when oil is used.

Putty Joints for Works' Mains.—The delay, inconvenience and cost of making repairs or changes on works' apparatus connected to mains with bell and spigot joints are much decreased by substituting putty for lead in the bells, after yarning. Especially is this applicable to the exhausters and station meters, which are more likely to require detaching from their connections than the other apparatus.

Pencil Holder for Registering Gauge.—Fig. 11, Plate II., exhibits a device to ensure even lines on the sheets of recording pressure or exhaust gauges, regardless of any irregularities in the surface of the carrying cylinder. The small weight may be adjusted within

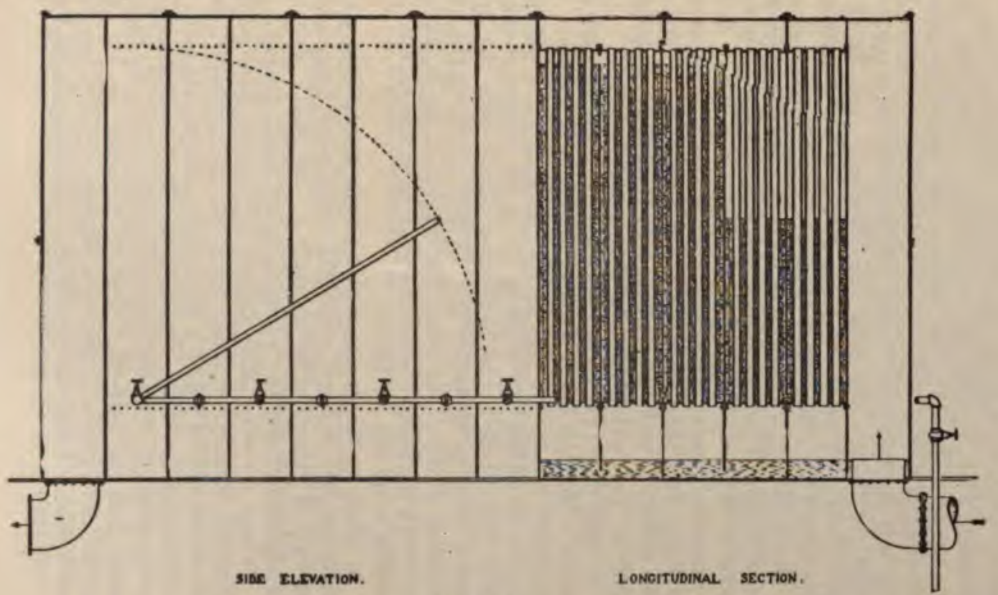
"WRINKLES,"

PLATE III.



SCALE.

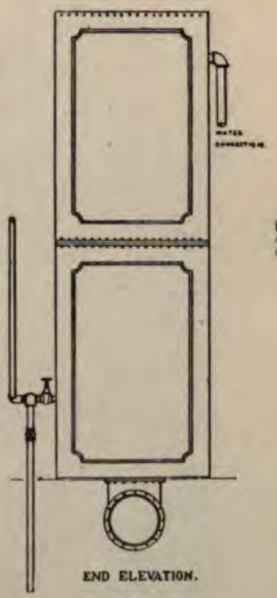
LOCATING A WATER LEAK ON A MULTI-TUBULAR CONDENSER.



SIDE ELEVATION.

LONGITUDINAL SECTION.

FIG. XII.



END ELEVATION.

FIG. XIII.

Geo. T. Thompson, Del.

a range of leverage entirely sufficient, and with a medium pencil a regular line is assured, even in damp weather, when a pencil held to its work by a spring will often tear the paper.

Photometer Screen.—After some experimenting, a photometer screen has been contrived which is simplicity itself—a ¾-inch tube and a piece of chalk. The tube is about 8 inches long, has its sides cut away for a length of about 2 inches near one end, and is supported in any convenient manner from the bar carriage, so that the centers of the openings are in line between the lights. An ordinary white crayon is cut to an edge on one end, at an angle of about 90°, and the sides of the cut surfaces are rubbed on paper to remove all scratches and to make the edge sharp. The chalk is then slipped into the tube with the edge vertical and toward the observer. It receives light through the side openings in the tube, and presents sharp contrasts of illumination until the proper point is reached on the bar, when the line of the edge will disappear, and the end of the chalk appear flat. So satisfactory has this screen been found, that it has superseded the other styles at both of our stations.

Safety Device, Ammoniacal Liquor Cisterns.—In storing ammoniacal liquor in cisterns, preparatory to shipment, it is often customary to cover the surface of the liquid to a depth of two inches or so with a moderately heavy oil, to prevent the loss of free ammonia. When so doing, care must be taken in pumping from the well, that the oil is not removed with the liquor. The attachment outlined in Fig. 5, Plate I., was devised to make this impossible.

A small pipe (⅜-inch is amply large), open both top and bottom, is placed within the one leading to the pump; its lower end being located above the lower end of the suction pipe, a distance equal to or slightly exceeding the depth of oil on the surface of the liquor. The small pipe, though communicating above with the open air, yet is sealed below in the liquid and so does not affect the pumping of ammoniacal liquor: but when the surface of the liquid is reduced to a level with the lower end of this small pipe, the vacuum is broken, and nothing more can be raised.

In fitting up this device it is obviously desirable to make the vertical pump supply, through which the small pipe passes, one size larger than would otherwise be necessary. The inner pipe may of course be adjusted to stop the pumping at any point desired.

Trench Work in Main Laying.—In laying street mains or services, especially where obstruction exists on the proposed line, the use of three T-pieces, of which a description follows, has been found of great convenience in readily obtaining the line of uniform fall. The tees are of wood, the cross-pieces being made all of the same size, and set square with the uprights. Two of the latter are just equal in length, but the third one is longer by a distance equal to the thickness of the cross-piece. From four to five feet is a handy length for the uprights.

In using them, the two equal tees are set vertically, one at each end of the line, their feet resting in the ditch at the depth desired for a bottom. To find the line for the bottom at any point between these, hold the third T vertically in the ditch at the place in question, and deepen the trench, following it with the T until, sighting across the top of that at one end, this middle one just cuts off the light between its under side and the top of the one at the opposite end. Trench work may thus be carried on past mortar and brick piles, intersecting streets, railway crossings, rock bottoms, or any temporary obstructions, with confidence in the certainty of being able to join the trenches later, and have all continuous. Whether working with or without instruments, the T-pieces will be found valuable.

Preventing Freezing in Exposed Supply Pipes.—Stoppages in exposed piping on train sheds, bridges, etc., in freezing weather, may be effectually prevented by passing the gas from a meter outlet through a box fitted with a tray carrying quicklime. The box should have a removable cover, and is preferably made of sufficient size to contain lime for an entire season. The quicklime, being broken into small bits, seizes upon all moisture in the gas with avidity, slaking the lime, and leaving nothing congealable in the gas beyond the desiccator.

Gas Engine Equalizer.—Where a gas engine is in use in a building lighted by gas, particularly where both burners and engine are fed from a small main pipe, annoyance is often caused by the jumping of the lights. To set a governor on the illuminating connection is an expedient which readily suggests itself, but this is not always wholly effective. In a case I have in mind, the remedy was found in placing at the outlet of the engine meter a holder, adapting an old 5-foot meter prover for the purpose, to act as a cushion between the engine and the main. The holder was counterweighted to "give and take" between strokes of the engine, and not only wholly stopped the fluctuations of the lights, but also proved of decided advantage to the operation of the engine, in serving as a reservoir for gas between the strokes.

Conclusion.—Credit for the originality of the foregoing wrinkles should include the names of Messrs. B. E. Chollar and Arthur Finnegan. In none of the principles outlined is anything left wholly to theory, for all are in practical employment or operation.

In conclusion, I offer the suggestion that a "Wrinkle Department" in our Association would bring to us as contributors many of our members who have never appeared on the paper lists, yet who could without doubt tell us of valuable contrivances or methods used by them which would be new and serviceable to us, yet which they might not consider sufficient in scope to warrant expansion into a regular paper. Such a department would supplement our Question Box very effectively. Contributions might be signed or anonymous, and might be read by the authors or by the Secretary, as the contributors chose. If this suggestion be favorably received, and the department instituted and continued, I feel sure that it will come to be second in interest to no other feature of our conventions.

DISCUSSION.

The President—We have heard a very interesting paper. Any other "Wrinkles" that any of you have to present will be in order in the discussion.

Mr. Jenkins—The governor spoken of by Mr. Thompson for gas engines can be used for any engine. Some years ago a two-horse power gas engine, placed in Goshen, Ind., could not be operated. I was then located at Elkhart, and I was asked to go to Goshen to see what was the matter with the engine. I found their only supply was a $\frac{3}{4}$-inch pipe—it was in the middle of the winter, the frost was four or five feet in the ground, and we were unable to dig down and put in a proper size service. A compensator, similar to the one described by Mr. Thompson, was put on this $\frac{3}{4}$-inch pipe, and it answered every purpose until spring came, when a larger service could be put in.

Mr. Ramsdell—I want to ask a question about Fig. 2 of Plate I. I have used this same device, gotten up in a little different form, but practically the same thing—taking the outlet and inlet on the top and bottom of the main instead of in the end. When I first put it up we had been having a great deal of trouble in our hydraulic mains, by reason of the thick pitch accumulating, and I do not think we were ever troubled with any thick tar afterwards. So I supposed it was a sure preventive. Since that time I have had the same device put on another hydraulic main, in which it did not work. The trouble continued. I would like to ask Mr. Thompson if, from his experience, he can suggest why it did not operate.

Mr. Thompson—Without knowing more about the details I do not know that I can answer you. How long was the hydraulic?

Mr. Ramsdell—One section.

Mr. Thompson—Had it any fall toward the outer end?

Mr. Ramsdell—That I cannot answer. I do not know.

Mr. Thompson—Were you running exceptionally high heats?

Mr. Ramsdell—No.

Mr. Thompson—The principle is perfectly correct, and there is nothing new in the principle of having the tar brought from the bottom with a pressure regulator at the top. That is used in a number of other installations. One advantage of this was its simplicity of construction. As the principle worked perfectly in one instance, I do not know why it did not in the other. Were both pipes clear?

Mr. Ramsdell—Yes.

Mr. Thompson—And it failed to work from the first?

Mr. Ramsdell—It was a question whether it worked from the first or not.

Mr. Thompson—I cannot aid you. The principle is correct, unquestionably.

Mr. Bredel—The principle is correct, but the practice is not. It may not drain out the water, and that is the reason you keep your heavy tar at the bottom.

Mr. Thompson—I do not understand you.

Mr. Bredel—The tar made is of different specific gravities, and you want to keep your water at a certain height. Tar is generally considered to have a specific gravity of 1.20, while water is 1.15 and 1.30.

Mr. Thompson—It is true you can regulate the height of the seal with such a contrivance as this; but what you have to regulate on the outside of the main is the weight of the seal. At the outlet and overflow you will always have tar. Within you will have heavy tar, light tar and ammoniacal liquor; consequently, while the weight will be the same within and without, your height is likely to be greater within than without, and when you put the main in operation you must adjust it to the point where there will be practical uniformity in the character of your overflow.

Mr. Bredel—I have never been able to do it. Of course it depends altogether upon the temperature of the outer air and the tar you make. The moment your temperature goes below 60° you are in trouble.

Mr. Thompson—Do you think it cannot be done?

Mr. Bredel—Yes.

Mr. Thompson—I know that it is done.

Mr. Bredel—It may be done in St. Louis, or it may be done where the hydraulic main is kept warm, but it cannot be done where the hydraulic main is kept cold. Another result will be stoppages from naphthaline in the overflow pipe. I have had experience with the same apparatus, and know that it cannot be successfully used except under certain conditions, and those conditions are very limited.

Mr. Thompson—What form do you recommend for the overflow?

Mr. Bredel—If I knew of any very successful overflow I would recommend it, but I do not know of any.

Mr. Thompson—Then you consider that this is the best of any that you are acquainted with?

Mr. Bredel—No; I don't consider this at all good. It is a thing which cannot be worked successfully under different atmospheric conditions.

Mr. Thompson—Mr. Ramsdell's experience shows that it did work in one case.

Mr. Bredel—Under certain conditions it will work, and under certain conditions it will not work.

Mr. Thompson—Our endeavors must be toward the direction of making it work by keeping the main warm; and that is practicable.

Mr. Somerville—I would like to say as to using this device as an equalizer, that I had some trouble when I first started gas engines by reason of the oscillation of the lights coming from the same pipe; but we adopted a much simpler thing than that. I happened to think about an old 10-light meter I had, and I attached it to the supply pipe and the oscillation stopped. It was effectual. If anyone is troubled with this oscillation, just put on an old meter by the side of the new one, and there will be no more trouble.

Mr. Boardman—Was it a dry or a wet meter?

Mr. Somerville—A dry meter.

Mr. Thompson—Was that because there was elasticity in the containing vessel, or because the gas in it acted as a cushion?

Mr. Somerville—The oscillation stopped, and I had no more trouble after putting on the old meter.

Mr. T. D. Miller—We have had trouble in finding how high up a condenser leak is. I am under the impression that I shall have to take out the pipe. I would like to know if there is any method of locating the particular pipe.

Mr. Thompson—Is it similar in form to the one shown in this sketch?

Mr. Miller—No; it is tubular.

Mr. Thompson—All in one section?

Mr. Miller—The gas goes up one side and down on the other.

Mr. Thompson—Is it in two compartments?

Mr. Miller—Yes, the gas chamber is.

Mr. Thompson—Have you found out which compartment it is in?

Mr. Miller—I think there is but one water compartment, from the fact that the water inlet and the outlet are on the same side.

Mr. Thompson—You have no circulation of water. This is a condenser arranged on the obviously desirable principle that water and gas circulate in opposite directions throughout the entire length; and where you have no circulation of water this device would not apply at all.

Mr. Cathels—With regard to the freezing of supply pipes, I would like to call attention to a method of prevention or remedy that was adopted by the late Mr. Forstall. He always ran service pipes in as straight a line as possible from the main to the meter. The same principle is adopted now by the Chicago Gas Light and Coke Company, and I adopted it myself after being advised to do so by Mr. Forstall. The remedy consists in placing a 4-inch sewer drip in the curb wall, running the service pipe straight through that, packing each end of the 4-inch sewer drip with oakum, leaving an air cushion in the center. That keeps the cold from striking the pipe. The metal absorbs the cold and carries it along, and that keeps the cold from going from the wall into the service pipe. In addition to that, if I am running a 1¼-inch service, I put a 1¼-inch service cock in the area way. I find that in locating a frozen pipe, 9 out of 10 are frozen at the service cock; and the brass, being contracted at that point, takes up the cold, and that is the weak point. I think it always advisable to put in a cock larger than the service pipe; and by using this air cushion in the wall it greatly helps in preventing the freezing of pipes.

The President—Mr. Thompson has another wrinkle which is not in the paper, and which he has not shown yet.

Mr. Thompson—I have just received from St. Louis the following message: "Feeder, fluid, alarm, muddy, nephew, jaw, raw, clear, good." That tells me the make at our works yesterday; the sendout, the yield per pound; the oil used; the illuminating power; the fuel coke used per 1,000 feet; the fuel coal used per 1,000 feet; the condition of the weather; the general conditions at our works—whether good or bad. The principle of the cipher is simply this: Two consonants are employed to designate each figure—each numeral, from 1 to 0, as follows:

1	2	3	4	5	6	7	8	9	0
S	N	M	R	L	T	D	F	C	P
B	J	K	G	V	Z	Q	X	H	W

There are two equivalents for each figure, in consonants, so that you have the choice of two consonants in indicating any single figure. The figures going to make up this report are as follows: "Feeder," signifies 874; that is, the figure 8 is the equivalent of either F or X; the figure 7 is the equivalent of either D or Q; the figure 4 is the equivalent of either R or V. Those consonants can be combined with vowels *ad libitum* to form any dictionary word. In translating, the vowels are disregarded, and only the consonants taken into consideration. The order of the words indicates their value. For instance, the first word indicates the amount of gas made in 1,000 feet; the second word indicates the amount of gas sent out; the third indicates the yield per pound; the fourth the quantity of oil used; the fifth the illuminating power; the sixth the fuel coke per 1,000 feet; the seventh the fuel coal per 1,000 feet; the eighth the condition of the weather; the ninth indicates the general condition at the works—as good or bad; and the tenth is for additional words which can be used for any remarks desired.

Mr. Ramsdell—I would suggest that the recommendation of Mr. Thompson, as contained in the last clause of his paper, that a "Wrinkle Department" be opened, be referred to the Executive Committee, which will meet some three months before our next meeting, and they can then announce the plan for such a department.

The President—I was going to suggest the establishment of such a department, and the appointment of Mr. Thompson as its superintendent.

On motion of Mr. Somerville, the thanks of the Association were voted to Mr. Thompson for his paper.

THE PRESIDENT—Is the Committee on Memorials ready to report?

MR. BUTTERWORTH read the following report, which was, on motion of Mr. Boardman, seconded by Mr. Jenkins, received, and the recommendations adopted by a rising vote:

REPORT OF COMMITTEE ON MEMORIALS.

Since the last meeting of this Association it has been made poorer by the death of five of its members, namely:

One Honorary Member—Mr. Geo. A. McIlhenny, President Washington Gas Company, Washington, D. C.

Three Active Members—J. F. Rodgers, Supt. Gas Co., New Decatur, Ala.; Geo. W. Ewing, Superintendent East St. Louis Gas Works, East St. Louis, Ills.; H. S. Walbridge, Vice-President Gas Light and Coke Company, Toledo, Ohio.

One Associate Member—John J. Griffin, President J. J. Griffin & Co., Philadelphia, Pa.

As our blessings brighten as they vanish, so does our appreciation of our brothers who are thus from time to time taken from us. We are suddenly made to realize, more clearly perhaps than ever before, the excellence of their characters, and we feel a pang of regret and self-reproach that we did not honor and love them more nearly as they deserved while they were with us.

While much could be said in eulogy of the personal and professional merit of those members who died during the year, the Committee must content itself with the submission of the following resolutions:

Resolved, That we hereby testify to the love and respect in which we hold the memories of those members whom we have recently lost, and to the fact that we are the better for having known them in life.

Resolved, That we tender to the families of these deceased members our sincere sympathy for them in their bereavement, and that the Secretary be instructed to transmit to them a copy of these resolutions.

IRVIN BUTTERWORTH,
R. R. DICKEY,
F. M. DOAN,
Committee.

Mr. H. D. Walbridge, of Grand Rapids, Mich., then read the following paper on

THE DUTY OF GAS COMPANIES TO THEIR CUSTOMERS.

Mr. President and Gentlemen of the Association: As a rule, I think we do not approve of apologetic prefaces to papers read before us, but the subject the Executive Committee has assigned me is so broad and long and deep that in a short paper I shall hardly be expected to more than suggest some of the important obligations of gas companies to their customers; even this I undertake with diffidence and hesitation, well aware that I am addressing gentlemen much better informed, through experience, observation and study, than myself, and to whom I often go for information and advice.

Most manufacturers have the entire world for a territory, and rarely or never meet those who buy their goods; but the territory of the gas company is necessarily limited, and the relations between customer and producer are close. Upon the nature of these relations, whether cordial or the opposite, depends in a large degree the full success of the enterprise In my opinion a simple definition of the duty of a gas company to its customers would be that duty which it owes to itself. Hence a company will best promote its own interests by giving every attention to the interest of its customers, and letting the customers know it, and, if possible, make them appreciate it. On this occasion, to better illustrate my remarks, I will organize a new company. It will be in some respects ideal, and I will tell, not how the company I represent is managed, nor how any other company I ever heard of is conducted, but in its management will be the good points observed in many. We will call it the Utopia—an excellent name for the promoters to use in a prospectus.

The Utopia will have a reasonable capitalization—a most vital point in the success of any enterprise, and especially so in the gas business. The manufacturing department will be well and economically managed—something we all recognize the importance of as one of the first duties to ourselves. With reasonable capitalization and a high grade, economically produced gas, with the resultant possible low price, based on consistent though possibly different rates for various quantities or uses, we have only to consider the relations of the Utopia to its customers. The first and one of the most important factors is the office—that department which comes most directly in contact with the public. In the office of the Utopia, placarded all over the walls, will be the legend, "We strive to please;" the head clerk or clerks will be affable, amiable and of pleasing address, and will be thoroughly informed upon every detail of the gas business. He will be able to answer all sorts of questions. and will have the tact and *time* to pacify and satisfy those who come with fire in their eye. Outside the office he will have the faculty of making friends and keeping them. The clerical force will, of course, be careful and intelligent, thereby insuring prompt and accurate information as to accounts, etc.

In the distributing and sales department of the Utopia will be cast-iron rules governing the employees, which will insure prompt and efficient service to the customers, and in this department the legend "No trouble to show goods" will be written in letters of shining gold The department will be in charge of a competent foreman or superintendent, who will be subordinate to the office. Meters will be set promptly, the same day, or even the same hour as ordered, if need be. Stoves and apparatus will be promptly set when ordered, the connections will be left gas tight, and the customer will be fully instructed as to the operation of the apparatus. Meters will be cheerfully tested whenever the request is made, or when questions arise as to their accuracy, and without charge. Complaints of all kinds, no matter now seemingly trivial, will receive full consideration and prompt attention; defects will be remedied or removed when they exist, and the cause fully explained to the customer. Gas leaks of any nature, whether in company's mains and pipes or in the pipes and fixtures of the customer, will be promptly investigated and stopped without charge. Under no consideration will the Utopia allow any of its employees to empty or spill condensation from meters or drips either in the public street or alley, or around any private premises, causing dissatisfaction and disgust to a customer or to a prospective one. Poor lights and unsatisfactory service will be given special attention and the causes removed. If the service pipes or meters are too small, they will be replaced with larger. If the internal piping is at fault the difficulty will be fully explained and a remedy suggested. If a fixture is stopped up, it will be taken down and cleaned. If the burners are poor, good burners will be provided. The Utopia will be determined to satisfy its customers and make them feel that an honest endeavor is being made to give them the best there is to be had. Good, ordinary lava tip burners are inexpensive, necessary to a good light, and will, of course, be put on free. When a customer, as they will sometimes do, complains of the size of his gas bill—well, gentlemen, that is a point upon which I have had some experience, yet I am to-day as unable to offer any suggestions as when I entered upon my career, and the Utopia's method of dealing with this class of complaints I will leave to your imagination.

At the Utopia's office, or shop, will be a man from 6 P.M. to 6 A.M., competent to receive and record complaints *and attend to them;* in addition to this, he will attend fires that occur on the line of the company's mains, to save meters and property and prevent waste of gas. The company will be anxious to accommodate its customers night or day, and its aim will ever be to keep its customers satisfied. This company will not be satisfied to maintain an office with the service I have described and wait for customers to come in; it will send out and bring trade in; it will have an advertising department, and will conduct an educational campaign; it will have the right sort of literature to convince people that its gas is one of the best and greatest things on earth. This literature will be neatly printed, appropriately illustrated and readable. The pamphlet issued in 1892 by the Columbus (O.) Gas Company, is an admirable example of ideal gas advertising literature, and is one of the best things of the kind I have seen. The Houston (Tex.) Gas Light Company recently sent its customers a burner cleaner, with a neat card attached, instructing customers how to use it, and the card serves the double purpose of advertising the company and saving the cleaner from being lost. The London (Ontario) Company issued a pamphlet in 1890, descriptive of gas cooking stoves, which was original, and as an advertising medium first class. The Minneapolis Company issued a pamphlet somewhat similar in its scope, and other companies have done the same, presenting the advantages of gas in an attractive and readable form, and telling of the many uses to which it can be put. There can hardly be too much of this sort of stuff, and the Utopia will have lots of it. In this bureau of publicity will be a competent man, whose duty it will be to drum up trade; he will solicit orders for stoves and other apparatus, will visit builders of new houses and blocks to see that provision is made for use of gas, and then see that work is put in properly; for the company will have rules regulating all internal gas piping for both light and fuel purposes, *and will enforce them.* He will be an eloquent man and of agreeable manners, and will leave a favorable impression upon the people he meets. In the winter, when the stove business is quiet, he will be constantly employed visiting customers, to see that their service is satisfactory, and either reporting or personally remedying defects which he discovers, but which might not otherwise come to the company's notice. How many old iron fishtail burners with one opening completely stopped, and giving practically no light at all, do you suppose a man would find in a town of 50,000 population on his first tour around in the fall? What a general improvement in the condition of the gas lighting apparatus would follow his work. This man, on his visit, will make practical suggestions to the customers in the direction of improvement in their service. He will suggest a check or governor burner where gas is wasted through lack of them, and in various other ways will show that the customer's interest is near to the heart of the company. He will tell of improved appliances and hint at new and desirable apparatus, and will always assure the customer that he or she will be a welcome visitor at the office, where it will be "no trouble to show goods."

Even though the Utopia may not carry a stock of stoves, heaters, and other apparatus, it will be fully informed as to the stove business done in the town, and will carry a full line of samples of apparatus in its office, and will be able to refer the customer to a reliable dealer from whom to buy. The Utopia will certainly carry and exhibit a full line of all the best and latest improved burners and gas-light apparatus, together with the necessary glazed and experimental meters, photometer, etc., for exhibiting and explaining their efficiency, and it will probably have the stoves, heaters and other apparatus as well, all of which it will be prepared to deliver and place ready for use. The stove and apparatus branch of the business will be conducted on a liberal, broad-gauge system—"satisfaction guaranteed or no sale." Goods will be sold on contract and easy payments when necessary. The company will lose nothing on its sale of apparatus, but the profit will be reduced to a minimum. The Utopia will never antagonize another reputable dealer in gas appliances.

Following the policy I have outlined, you can imagine the Utopia standing well in the community, its relations to its customers of a most friendly nature, and its business steadily increasing. Its only enemy and most formidable obstacle will be ignorance, and the company, dependent upon its size, will feel justified in spending an amount equal to from 2 to 10 per cent. of its gross expenses each year in advertising gas and educating people how to use it properly. I venture to say that it is the experience of you all that more complaints and more dissatisfaction arise from ignorance than from any other source, and that money expended in education is well and profitably expended and will yield a rich dividend. Whether or not the Utopia will be a success from a dividend-paying point of view, I will leave for you to determine. The capitalization will be reasonable. In the mechanical department all the best appliances and methods will be found, and its relations to the public will, I think you will admit, be cordial and all that can be desired. The company, in effect, will be doing business on the same plan as the grocer and the dry goods merchant. Its business will be to sell gas, and its motto will be, "No trouble to show goods." It will treat its customers as the merchant treats those who deal with him; it will give satisfaction or know the reason why, and no trouble or expense will be too great to remedy defects in the service to its customers. It is largely to the increased consumption that we must look in the future for means to reduce prices on our product and increase our net profit. To inincrease consumption the company must first use every possible means to furnish a high grade of light, and then educate and help its customers to use it to the best advantage. Literature and solicitors are good advertising mediums; but, after all, the best, most profitable and the cheapest advertisement that any company can obtain is customers well satisfied with what they get and well pleased with the treatment given them.

DISCUSSION.

THE PRESIDENT—You have listened to a very interesting paper on the policy adopted and in practice by the Grand Rapids Gas Company. Please give it a full criticism. A paper of this character should not go out without something being said about it.

MR. SOMERVILLE—I think Mr. Walbridge omitted to mention that the Utopia Gas Company ought to have a man with four hands and be capable of being in two places at once, as otherwise the Utopia office would be short of a man from 6 P.M. to 6 A.M., and they could not receive, record and attend to the complaints. I do not see very well how a man can attend to complaints and still be at the office. The idea, of course, is very good; but I think that the Utopia Company ought to be under the Board of Commissioners, so that while doing so well by the consumer some other company would not come in and turn the Utopia Company out. That would be my experience. The more we do, perhaps, the less thanks we get for it.

Mr. Odiorne—I would ask Mr. Walbridge what he does when a customer says that his bill is too high; that he has not used the amount of gas charged for, and that he would like a new meter. Do you give him a new meter?

Mr. Walbridge—Yes; right off—anything that he wants.

Mr. Butterworth—I think that Mr. Walbridge answers the question exactly right. I would give him a new meter and satisfy him.

Mr. Odiorne—You would have to give a good many new meters.

Mr. Walbridge—I would give him two if he wanted them.

Mr. Murdock—Ordinarily, one meter satisfies them.

Mr. Walbridge—In reply to what Mr. Somerville said, I will say we have an arrangement with the Telephone Company by which any complaints received during business hours are made a note of in the telephone office; and when the man returns to the office he gets a memorandum and attends to it. We have no difficulty in promptly answering complaints, but if it is necessary to have four men for this work—or whatever number it is necessary to have to attend to it properly and promptly—have them.

Mr. Geo. Treadway Thompson—In any town where such an arrangement can be made with the Telephone Exchange the complaints could, no doubt, be covered by the Telephone Company; but what would you do if a complaint came to the office in person?

Mr. Walbridge—Have another man, if necessary.

Mr. Thompson—If the man is on duty from 12 o'clock noon, until about 11 o'clock at night, the greater part of the complaints will be received during that time, which would practically leave all the district covered by any company without any one to complain to at the office, unless the complaints were sufficient to require the services of another man while the other was out.

Mr. Lansden—I believe in giving prompt attention to complaints. As a general thing gas companies, the larger they get, the more careless they are about individual complaints. We have never had such weather in Washington as we have had this year; and we found it necessary to establish a telephone service until 9 o'clock. The result has been that we have had as high as 10 men out attending to complaints at night. My idea is to educate the consumer.

Mr. Boardman—It seems to me the paper read by Mr. Walbridge is excellent as a suggestive paper, and that to go into the matter of details in all its departments is hardly fair to the writer. The paper sets forth the points towards which we must strive. None of us can hope absolutely to reach them all. The idea of the paper is that in the general conduct of the business we should strive to make it acceptable always to the consumer, strive to please the consumer in every reasonable request that he may make, and to educate him where he does not understand all the troubles that are coming up as we understand them. It is, as he says, because of ignorance that a great deal of the dissatisfaction expressed by our consumers arises. With patient explanation from an intelligent and affable official a great deal of trouble between the consumer and the company can be done away with, and a disgruntled consumer changed into a friend to the gas company. It is for that general plan as laid out in his sketch of Utopia that I think we are indebted very largely to Mr. Walbridge for presenting it in such a form; and it is to the importance of striving to reach this perfection that he outlines in his imaginary company that we wish to call the particular attention of many of our younger gas managers. I move a hearty vote of thanks to Mr. Walbridge for the paper which he has so kindly given us. (Carried.)

THE PRESIDENT—We will next listen to the paper, by Mr. O. O. Thwing of St. Louis, on

GAS ANALYSIS.

In Winkler's "Handbook of Technical Gas Analysis," the author makes the following statement: "In order to arrive at results which satisfy practical requirements, without laying claim to the utmost attainable degree of accuracy, technical gas analysis must first and foremost aim at working by the simplest possible means and with the least possible waste of time * * * Analytical results, which the manager of the works can only receive from the chemist after the lapse of days or weeks, are in most cases entirely useless to him, let them be ever so accurate." All "gas men" will undoubtedly endorse the distinguished author's statement, and will also agree that there is another qualification which might be made—that of cheapness. In the hundreds of small works scattered over the country there are superintendents to whom a knowledge of the constituents of their gas, especially the impurities, would be of great benefit, but who do not feel justified in purchasing an expensive outfit for the purpose of analysis, or perhaps doubt their ability to use one if they possessed it.

It is the object of this paper to describe an instrument, which, in simplicity and accuracy, will compare favorably with any apparatus designed for the analysis of gas by absorption. It can be used intelligently by any one who can compute percentage, and a ten-dollar bill will cover the expense of a laboratory which will be a surprise and delight to its possessor.

This instrument is called the Cooper's Tube or Eudiometer, and was first made for and used by Mr. Lewis Thompson of England. It seems not to have met with much favor from the start, and very little mention of it will be found in any of the technical books. About the year 1888 Mr. B. E. Chollar, then of Topeka, Kansas, realizing the desirability of a cheap and simple means of gas analysis, and believing that there were possibilities in the Cooper's tube which had been overlooked, designed it in its present form. Since that time it has been in almost constant use in works under his management, and has more than met the expectations entertained of it at the beginning.

It consists of a glass tube, enlarged to a bulb at the closed end, and bent about 2½ inches from the open end, so that the short leg forms an angle of 45° with the tube. Three sizes, called respectively 10 per cent., 25 per cent. and 50 per cent. tubes, will be found sufficient for gas analysis. The 10 per cent. tube shown here is 22½ inches in length, and its volume to the 1,000 mark on the leg is 200 cc. This volume is divided into 1,000 parts, of which 100 parts, or 10 per cent., is contained in the graduated portion of the leg. This is graduated into 100 divisions, beginning at 900 near the bulb and ending at 1,000 near the bend. Each division, therefore, of the leg indicates one part in 1,000, or one-tenth of one per cent. of the whole volume. The 25 per cent. tube contains one-quarter and the 50 per cent. tube one-half of the entire volume in the graduated leg; they are graduated respectively into two and five parts per 1,000. (Fig. 1.)

In addition to the eudiometers there will be required a few glass beakers; a glass cylinder or equalizer, about 24 inches high, to contain water in which the tubes can be completely submerged; a rack to hold one or more of the tubes in an upright position, bulb uppermost; a stand on which the tube can be inclined with its mouth in a beaker of water to allow the saturated absorbents to run out; a 10 or 20 cc. pipette, and some flexible rubber tubing about $\frac{3}{16}$-inch bore. The absorbents should be as follows:

For hydrogen sulphide—a solution of arsenic.
For carbonic acid—a solution of caustic soda or potash.
For oxygen—a solution of pyrogallate of potash.
For illuminants—a solution of bromine.
For carbonic oxide—a solution of cuprous chloride in HCl.

The 10 per cent. tube will be found most useful in estimating the impurities in the gas; the 25 per cent. can be used to ascertain the amount of oxygen, illuminants and carbon monoxide; while the 50 per cent., with glass stop cock at end of bulb, may be used as a gas burette to estimate hydrogen and methane by combustion.

In starting to test foul gas for impurities, first fill a beaker and the equalizing cylinder with water that has been standing in the room long enough to acquire the temperature of the surrounding air. This water should be clear, but not necessarily distilled. Take a 10 per cent. tube and with a piece of rubber tubing make a connection at any convenient point on the foul main. If the connection is made to uncondensed gas, it is well to interpose a tube filled with waste or some fibrous material to extract the tar, which would dirty the eudiometer. After connecting the rubber tube allow the gas to blow through it for a few seconds, and then push it into the eudiometer past the bend and up into the bulb. If the tubing is wet this can be done very easily. Allow the gas to blow for two minutes, or until it has displaced all the air, and then slowly withdraw the rubber tubing (allowing the gas to blow meanwhile), and quickly close the mouth of the eudiometer with the thumb or a rubber stopper as the tubing emerges. Place the foot of the tube in the beaker of water, and allow water to enter and seal off the gas at the bend. Immerse the tube in the equalizer and hold it in place beneath the water by means of a weighted cover until all contraction or expansion has ceased, which will usually occur in a minute or so. Then raise up the tube as quickly as possible, and when the levels of the water inside and outside of the tube coincide, read the volume of the enclosed gas as indicated by the graduations on the tube. By this means the volume is determined at a constant pressure and temperature. If the gas should be cooler than the water at the start, it will probably expand so that a reading cannot be taken. In that case take the tube out of the equalizer and carefully allow enough gas to escape to allow a reading to be made. (Fig. 3.)

After noting the volume of the gas, place the tube in the rack and with the pipette draw the water from the short leg (Fig. 4), being careful not to break the seal at the bend, which would allow air to enter and mix with the gas. Fill the space left in the short leg with the arsenic solution, close the mouth of the tube with the thumb or rubber stopper, being careful not to enclose any air in doing so, allow the solution to run into the bulb, and shake thoroughly to bring the solution in contact with the enclosed gas. After two or three minutes shaking run the liquid to the bend and into the short leg, expelling all the gas back into the long leg and bulb. Be very careful that no gas remains in the short leg. Immerse the mouth of the tube in the beaker of water and remove the thumb or stopper. The gas will contract and more or less water, according to the amount of H_2S there was in the gas, will rush into the tube. Lay the tube on the stand, with its mouth sealed in the beaker of water, in such a position that the solution by its greater gravity will run out and clean water take its place (Fig. 2). When this has been accomplished immerse the tube in the equalizer, and when the gas has ceased to expand or contract, read the indicated volume as before. The difference between the first and second readings indicates the proportion by volume of H_2S there was in the foul gas.

Take the tube with the gas remaining in it, which is now free from H_2S, and repeat the preceding operation, only using the caustic potash or soda solution in place of the arsenic. The difference between the second and third readings indicates the proportion of CO_2

FIG. 1

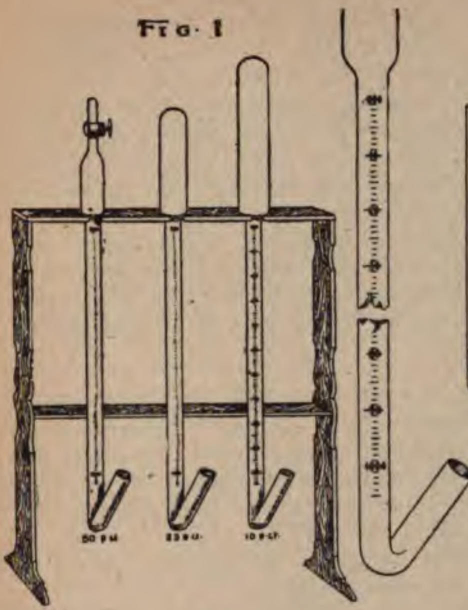


FIG. 4

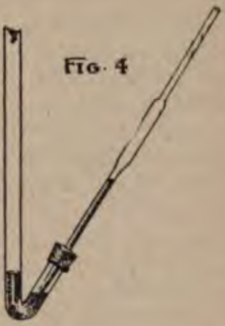


FIG. 3

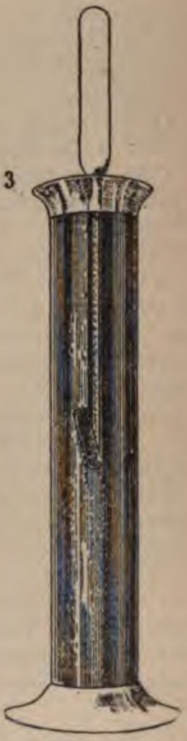
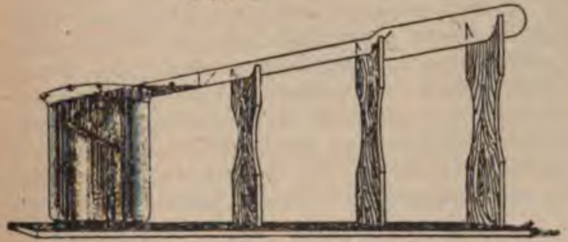


FIG. 2



Suppose the results to have been as follows:

First reading—original volume	1,003
Second reading—after As_2O_3	984
Third reading—after KOH	972

We therefore have found in the original 1,003 parts of gas, 19 parts of H_2S and 12 parts of CO_2, which is equivalent to 1.9 per cent. H_2S and 1.2 per cent. CO_2. If the operator should prefer to compute the percentage it would give 1.894 per cent. H_2S and 1.196 per cent. CO_2, which looks very scientific and amounts to nothing.

The determination of impurities in the gas, as given above, will be of the most practical value and interest to the gas manager, but if he wishes to delve deeper into its mysteries, let him take the proper eudiometer and extract the following constituents in the order given:

1st. Sulphuretted hydrogen.

2d. Carbonic acid.

3d. Illuminants, by bromine solution. This absorbent should be shaken with the gas for from 5 to 8 minutes. An expansion will probably occur after this operation, caused by bromine fumes liberated at the time. These can be absorbed by treating the gas with the potash solution after the bromine solution has been removed. The reading must not be taken until this is done.

4th. Oxygen, by means of pyrogallate of potash. Two or three minutes shaking will suffice for this operation.

5th. [illegible] by cuprous chloride solution. This will re- [illegible] shaking, and even then not all of the CO will [illegible] CO by cuprous chloride is purely [illegible] About 5 per cent. of the CO will re- [illegible] indicated by contraction. [illegible] 2 per cent. CO, the corrected amount [illegible] the potash solution again after [illegible] acid gas which may have [illegible] for this purpose, be careful to [illegible] of the tube before introducing [illegible] CO [illegible] from its absorbent.

[illegible] eudiometers and beakers [illegible] analysis. The water in the [illegible] care is taken to thor- [illegible] immersing them.

[illegible] hydrogen and meth- [illegible] apparatus and [illegible] manipulation. It cannot be [illegible] those who are familiar with other appa- [illegible] easily it can be accomplished with this one.

APPENDIX.

1. *Beakers and Pipettes.*—Griffin's lipped beakers No. 5 or 6, holding ½ pint to 22 ounces, will be found most satisfactory with this apparatus. Ordinary volume pipettes of 10 to 20 c.c. capacity will answer all purposes. A small cork can be bored and slipped over the end to prevent the pipette from entering the leg of tube too far.

2. *Solutions.*—It is well to buy chemically pure reagents, as the difference in cost is trifling, and enough for an extended series of experiments can be bought for two or three dollars.

To make the arsenic solution, put about a teaspoonful of arsenic in a pint of distilled water and keep it near the boiling point for an hour or so. Arsenic is almost insoluble in cold water, but by this means a strong clear solution can be obtained.

Caustic potash or caustic soda is obtained fused in sticks, and a moderately strong solution can be used, as experience suggests. The writer prefers to cut off a small piece as large as a pea from the end of the stick and allow it to dissolve in the tube.

Pyrogallic acid is in the form of a white powder, which is extremely soluble in water. Only a little of this should be made up at a time. Dissolve a teaspoonful in a six-ounce bottle of distilled water, and it will suffice for many experiments. Add the KOH to the solution after it has been poured into the eudiometer.

Bromine should be diluted with several times its volume of water. Great care should be taken not to inhale any of its fumes.

To make the cuprous chloride solution, dissolve an excess of the white monochloride of copper in hydrochloric acid. The excess will sink to the bottom of the bottle. A few pieces of metallic copper should also be added to the solution.

DISCUSSION.

THE PRESIDENT—You have heard a paper showing us how every man can be his own chemist. Mr. Thwing will now, as far as he is able, perform a few experiments. These jars are all filled with coal gas—it is St. Louis gas, and I hope Mr. Thwing will not find it too bad.

MR. THWING—This is unpurified gas—taken from before the washer. While on this subject I will say that any of you who have a Standard scrubber, or any means of saving ammoniacal liquor, you will find that the ammoniacal liquor will take out about 30 per cent. of sulphureted hydrogen from the gas. That is, you will find more sulphureted hydrogen before your scrubber than you will after it; or, in other words, the ammonia liquor acts in taking out sulphureted hydrogen from the gas. The first step in this analysis is to uncork the tube under water, which must be done in order to prevent any gas from escaping.

MR. D. MCDONALD—I would like to ask where that whole outfit can be bought?

MR. THWING—Mr. Emil Greiner of William Street, New York, furnishes these tubes to us. They are made to order, and he is the only person in the United States that I know of who can furnish them. The water has now sealed off the gas. There is nothing but gas in that tube now. Now it is placed in the equalizing chamber in order to equalize the temperature. The water of course, during several experiments, will not change its temperature at all, especially if it has been kept in the room for some time before. The water should be as near the temperature of the room as possible, and it should be allowed to stand in the jar for some time before the experiments are made. A part of this water is warmer and a part is colder than the air. Now that the gas has come to a standstill, I remove it. That reads 999. There are, therefore, 999 volumes of gas, or the gas in the tube is divided into 999 parts. If you will refer to the paper you will see there should be a rack whereon to set the tube, in order to introduce the pipette. This is the arsenic solution, or arsenious acid. It is common commercial arsenic. This pipette is used for extracting the liquid from the short leg. That cork is placed there so that the end of the pipette will not reach below the bend, and not allow the air to enter into the long leg and bulb. Now the arsenic solution has been placed in the short leg. I have corked it up under water so as to allow no air to enter. Now it will run down into the bulb. That purifies the gas the same as an oxide purifier does; that is, it takes out the sulphureted hydrogen. Anyone who experiments with this apparatus will notice that if the gas is taken before the ammonia is extracted it will not stain the solution at all, it will be reasonably clear; but if it is taken after the ammonia is taken out, then the solution in the bulb will turn quite yellow. Now the water level should rise in the tube when the cork is taken out. You notice that it does rise to an appreciable extent. There should be a stand here to rest the eudiometer on, so that the solution will run out. You will see that the greater specific gravity of the arsenic solution caused it to run out of the tube and the clean water takes its place. The solution should be allowed to run a little longer, but as the time is short we will let it go at that. Now the tube is placed in the equalizing chamber again so as to cause the temperature of the gas in the eudiometer to correspond with that of the original reading. The present reading is 987; the former reading was 999. This makes 1.2 per cent. of sulphureted hydrogen in the gas. The next step is to take out the carbonic acid with caustic potash or caustic soda. This is caustic potash that I have here. The amount of ammonia in the gas is so small that, although it could be determined by using sulphuric acid, it would not amount to much—volumetrically it would be very small. This caustic had better be handled with tongs, as it has a destructive effect on the skin. It can be handled several times, but in the end it will cause trouble. It dissolves in water very quickly and takes out the carbonic acid in the gas. Now the piece of caustic potash that I placed in there has completely dissolved. Its action on carbonic acid is very quick, and by the time it has dissolved it has taken up all the carbonic acid in the gas.

MR. LANSDEN—What is the reaction?

MR. THWING—It forms carbonate of potash. Now you will see that the heavier liquid is running out of the bottom, and lighter liquid is taking its place in the tube. After each operation the gas must be equalized, of course, in pressure and temperature. The reading of the leg this time is 977, showing 1 per cent. of carbonic acid. I think that these percentages obtained to-day are a little less than they should be. The gas was simply taken into tubes and stopped with rubber stoppers, and I have found by experiment that this system of sealing will not confine the gas altogether. That is, if you inclose a sample of foul gas in a tube sealed with a rubber stopper, leaving it so remain for several days, you will find its percentages of impurities will be much smaller than if you analyze it directly. In order to keep a sample for some time you should seal the mouth of the tube thoroughly. I think that rubber absorbs some of the impurities. The next step will be to take out some of the illuminants by means of a solution of bromine. I have not filled any of the smaller percentage tubes with gas, and so I will have to go as far with the 10 per cent. tube as I can. You will notice how the bromine fumes fill the tube. The water has absorbed nearly all the bromine in this case, as the water was a little alkaline. The reading, after using the bromine solution, is 933. That taken from 977 leaves 4.4 per cent. of illuminants. After the bromine solution the pyrogallate of potash solution should be used. I will skip that. After the pyrogallic acid solution for testing for oxide is used, the cuprous chloride solution should be used in testing for carbonic oxide. That will extract the carbonic oxide from the gas. This must now be shaken up for a considerable time in order to absorb as much as possible of carbonic oxide. I think that will be sufficient to show the action of the cuprous chloride solution in testing for carbonic oxide. Of course, it has now to be equalized and read again. In this connection, I wish to draw special attention to the fact that the absorption of carbonic oxide by the cuprous chloride solution is purely mechanical, and not at all chemical. In using the potash solution after the cuprous chloride solution be careful to let the tube stand long enough to allow all the cuprous chloride solution to run out before inserting the potash. It has been suggested that I should show you how to allow some of the gas to escape when the reading is too far down the tube; that is, if the gas is cooler than the water in which you immerse it to equalize the temperature, it will expand, and occasionally it will come clear down to the bend. Then, of course, you cannot read the volume of the gas at all. Suppose it was in that position; place it in the beaker, place the

[illegible] that way, and allow a little of the gas to run into the
[illegible] Then place it down in the beaker and remove the thumb
[illegible] allowed enough gas to escape to enable you to make
[illegible] the long leg without allowing any air to mix with it.
[illegible] the method of testing the air for oxygen. In washing
[illegible] we should have a connection with the hydrant, or with
[illegible] a small rubber tube into the eudiometer and allow
[illegible] and wash it out thoroughly. If you have no water
[illegible] take a beaker, pour water, holding it in position so
[illegible] run down the short leg and then down the long leg
[illegible] This tube is now supposed to be filled with air. Twenty-
[illegible] the volume enclosed is in the leg of the tube. This
[illegible] pyrogallic acid. This is the pyrogallic acid as it can be
[illegible] a white powder. You can absorb a large quan-
[illegible] amount of water. The reading on this 25 per cent.
[illegible] It is best to put in the pyrogallic acid first and the
[illegible] because if the two together are allowed to unite
[illegible] the oxygen from the air. This is caustic potash that
[illegible] with the solution of pyrogallic acid. You notice
[illegible] a very dark color as soon as it combines with the
[illegible] oxygen in air with these absorbents I have always
[illegible] I believe that the books give 20.7 or thereabouts.
[illegible] the method of taking oxygen out of any gas sufficiently
[illegible]

[illegible]—Can marsh gas be determined in that simple
[illegible]

[illegible]—No; determining marsh gas is quite a complex process.
[illegible] be burned to carbonic acid, which is absorbed by
[illegible] titrated with oxalic acid. The method of deter-
[illegible] gas is to burn it over oxide of copper in a porcelain
[illegible] no absorbent at all. That is the purpose for which this
[illegible] tube with a glass stopper was designed. The gas can be
[illegible] these tubes through a porcelain tube and then burned over
[illegible] acid and absorbed further on.

[illegible]—You can approximately get it by explosion?

[illegible]—Yes; it is about the same thing. If extreme accuracy
[illegible] a sample of gas it would be well to fill the eudio-
[illegible] but I have found that for ordinary gas analysis it is
[illegible] displace the air with the gas as it is to fill the tube with
[illegible] if you fill the tube with water to the top, and then
[illegible] position, the water will remain in the tube, and then
[illegible] connection to any gas supply, and by running the
[illegible] bend and up into the bulb, you can displace the water
[illegible] absolutely sure that there is no air in it. I made
[illegible] in that manner and found that the results coincide,
[illegible] displace water with gas or displace air with gas. The

way of filling the tube is to make your connection, of course, to any part of the works you wish to get the gas from; insert the rubber tube in the eudiometer and let it run up in the bulb, and allow the gas to flow for a few moments, and then, when you are satisfied that the gas is displaced here, slowly withdraw the tube. It is well to watch the mouth of the tube to see that the gas is flowing, because sometimes there will be a kink or a stoppage in the tube which will prevent the gas from flowing. So you need to watch it closely. Then, by slowly withdrawing the tube in this manner, you can be satisfied that the gas has displaced all the air in the eudiometer. When the tube is ready to be withdrawn I simply pull it out in this way. It can be closed by simply holding the thumb there, and as the rubber tube comes out slip the thumb over the opening.

THE PRESIDENT—If any member wishes to ask Mr. Thwing any questions there is now an opportunity.

MR. WOODWARD—How long does it take in practice to make that analysis by making those five absorptions?

MR. THWING—It would probably take three-quarters of an hour to go through the whole thing. And, by the way, I will say that in testing gas it is a very nice way to take three tubes and fill them all at about the same time. Then you can have one tube equalizing, another tube emptying into the breaker, and in the remaining one you can be shaking the absorbent. In that way you can have three operations following one another, and thus you make three analyses in almost the same time required to make one.

MR. BREDEL—I would like to make a few suggestions about how to prepare the solutions. Also about the water used in the breaker and in the equalizer. I think it would be a good plan to use purified gas and saturate the water completely with the gas. so as to absorb all the illiminants that the water will absorb at any time. Then make your potash solution as strong as possible (say, about 1.26 specific gravity), and you will have no danger of absorbing the illuminants with the water. That is to say, make all the solutions out of distilled water that is completely saturated with gas.

MR. THWING—I would say in that connection that the absorption of illuminants by water would be very small anyway. In fact, any gas analysis in which water is used as the sealing fluid, and in which solutions are used in this way, cannot be absolutely correct. The only way in which they can be made correct is by using the bunsen tube and a mercury seal. You cannot expect to be absolutely correct with this plan.

MR. BREDEL—That would be so for water gas. Coal gas, not containing so many illuminants, the illuminants are not so readily absorbed by water as are the illuminants of water gas. Therefore, in water gas it is practically absolutely necessary to saturate the water in the beaker and equalizer, and of your solution, with purified gas.

That can be very easily done, and without much trouble. Another thing. The monochloride solution, as we all know, is very difficult to get pure. It will decompose into chloride very rapidly and become greenish. I have found that if I boil this with metallic copper for any length of time, say for three or four hours, and then close it hermetically, the solution will keep for a long time and be absolutely clear; and then the absorption is about three times as fast, and is a great deal more accurate.

MR. THWING—I have used a solution that has been kept for three years that had a little metallic copper in it, but the solution showed no sign of greenish tinge.

MR. BREDEL—Did you boil it?

MR. THWING—No; the solution was not boiled at all.

MR. BREDEL—I found that if I did not boil the solution it would take three times as long to absorb it.

MR. THWING—The absorption by the cuprous chloride solution is simply mechanical. It relieves the tension of the carbon monoxide. You cannot thoroughly clear it from the gas by the cuprous chloride solution.

MR. BREDEL—I found that in a gas containing from 20 to 30 per cent. of carbonic oxide it would all be absorbed by changing the gas 15 or 20 times; but with another part of the solution it would take 50 or 60 times. That is the difference.

MR. THWING—I have never had that experience. In most tests the same solution is used successively for condensing or absorbing the constituents of gas, but in this case a fresh solution is put in in every case, and a fresh solution acts much more quickly than a solution which has been in use for some time. In the Hempel apparatus the solution is used over and over again, and if you put clean gas in a Hempel apparatus, which has been used for taking out carbonic oxide, you will find carbonic oxide in the gas even when there was none there before. I may say that in making the test we use a very large excess of cuprous chloride.

THE PRESIDENT—What these gentlemen have been talking about we practical gas men will very seldom have anything to do with, and these tests may seem to some of us difficult and mysterious. Gas men want to test for carbonic acid frequently, but they will not need to make these other determinations perhaps oftener than once in three or four years. Most of these analyses can be made in 10 or 15 minutes. Are there any further remarks?

MR. JENKINS—I think that this has been a very interesting paper. The subject has been so treated that we, especially in small works, have had matters brought to us now that we have never been able to handle satisfactorily before. I move a hearty vote of thanks to Mr. Thwing for his paper, and for his experiments. (Carried.)

THE PRESIDENT—Next in order will be the reading of a paper, by Mr. J. R. Smedberg, of Chicago, entitled

WOOD GAS DURING THE WAR.

During the year 1854 a German named Breisach submitted a wood gas apparatus to the consideration of the trustees of the Philadelphia Gas Works, by whose authority it was put in operation and kept at work for a sufficient time to ascertain that it was capable of yielding a very good product from different varieties of wood, but was subject to certain derangements of parts, which it was desirable to avoid, if possible. Cresson's cellular retort was accordingly devised, in which the gas generated in a ⌓-shaped chamber, traversed several longitudinal passages under its flat bottom before reaching the stand-pipe. It was stated, as matter of official record, "that by the use of this improved appliance one cord of ordinary firewood of any of the commercial varieties yielded nearly twice the volume of gas obtained from a ton of the best Pittsburgh coal, the candle power being the same in either case."

The following values were obtained, viz:

One cord of ordinary pine, equal to 800 lbs. sperm.
One cord of oak or maple, equal to 900 lbs. sperm.
One cord carefully dried and split, equal to 1,300 lbs. sperm.

The illuminating power was about 25 candles for 4½ feet consumption, or say 5½ candles for each foot per hour.

The report for 1856 confirmed the previous statements as to the quantity and quality of gas obtained from wood.

The cost of making wood gas was stated as somewhat lower than that from coal, but the difference was not sufficient to justify the abandonment of the latter.

At the close of the year 1857, 30,000,000 cubic feet of wood gas in all had been made, the quantity of wood carbonized during that year alone being 1,717 cords. After this lengthened experience in the use of the cellular retort, it was no longer considered an experiment; the profits arising from it were stated to have more than repaid its cost twice over, and the important commercial advantages (in affecting coal contracts) contingent upon its possession were considered such as to make its continuance a measure of wise policy.

In spite of these favorable statements, which are quoted almost verbatim from the official reports, the wood gas manufacture obtained no permanent foothold in Philadelphia, or any of our middle or northern States.

Previous to 1861, these chambered retorts had been introduced in some of the southern cities, though the German practice tended to the use of large ⌓ retorts, such as were adopted in Savannah. We charged 1,000 pounds of wood per day per retort, employing 1½ hour charges, the yield per pound carbonized being 10 cubic feet of 18 to 20 candle gas, using iron retorts, as a matter of course.

One of the greatest difficulties connected with the necessary change from coal gas to wood gas was that of labor to cut the wood. All labor was rigidly controlled by the military authorities, and it was only after great trouble that a detail of fifty negroes and a white manager was obtained. Similar trouble occurred in securing railroad transportation, but this also was finally provided, and the supply of material thereafter was regular and certain. How different the southern light wood was from the pines, oaks or maples of the north will presently appear.

It was a common practice with southern planters to girdle the pine trees as the readiest means of securing the cultivation of their estates.

The leaves and branches soon fell off, and an almost immediate return was derived from the soil without the delay and expense of felling and burning the forest growth; for in many cases the naked trunks stood for many years, the sap drying out. the outer fiber rotting off, and the resin consolidating in the heart The short-leaved or "loblolly" pine undergoes no such change, in degree at least, owing probably to the much higher percentage of fibrous matter in its structure, and is, with the numerous deciduous trees, comparatively worthless as a gas producer.

It was to the long-leaved or maritime pine that the seaboard gas companies of the South had to look during the war for compensation for their exclusion from the coal markets of England and the North; and the keen spur of necessity soon developed elements of wealth in the forest about them. The long-leaved pine, of which the "loblolly" is the second growth, is the most abundant tree from Norfolk to Galveston for a hundred miles from the coast, its supremacy as a tree of the "forests primeval" being disputed in the swamps and brakes and jungles by other growths.

These vast original forests, girdled and standing for years as mentioned, become converted into what is known in the South as "lightwood." It varies much in quality with the size of the tree and the character of the soil, and is a very poor gas maker where the trees have been tapped again and again for resin, as in southeastern North Carolina.

A cord of first-class lightwood weighs 3,550 lbs., taking cutters' measure, which never holds out in re-cording, especially after a railway transit of fifty miles or over. Its weight is sometimes such that it will sink like a stone in water, though this seldom occurs except in the case of the knots, in parts of which not a trace of fibrous structure is discernible. These knots are nearly indestructible, and were sometimes used to form the step or "ink" on which works the main upright shaft of plantation horse powers, or for bearings in cotton gins. The average gas yield is 10 feet to the pound, the extremes being 8 and 15.

Remembering how rich the maritime pine is in resin, it would seem that the long continued action of the hot sun, joined in some areas to the occasional fires which attack the trunks without destroying them, drives in and accumulates the resin toward the center, while the outer annuli of fiber scale off or rot off under the action of these exterior causes. This gradual process finally gathers almost all the original gum of the trees in the heart, where the original moisture is displaced; until either the remaining fiber is embalmed in resin and thus preserved from further decay, or the trunk itself falls before the axe or the hurricane.

It is true that the quality of lightwood varies greatly in a field, all the trees of which have been girdled at the same time, but there can be little doubt that a very large and nearly uniform percentage of the original resin remains in each individual tree. Lightwood, then, is not a normal wood, as it contains a mass of the very richest hydrocarbons, with some varying but reduced proportion of fiber to act as dispersing material, and thus exercise an important function in fitting them for the uses of the gas maker.

In spite of the comparatively small amount of water held in lightwood, it was found necessary to shield it as carefully as possible from rain in order to obtain from it the highest yield and the best quality of gas. More than this, it rapidly deteriorates if split a long time before charging the retorts, even though under cover all the time.

It could not be advantageously used in the large shapes received from the cutter, any more than large lumps of coal, on account of the same difficulty of carbonization. Now it is known that the gas coals which yield the greatest volumes require the highest heats for thorough carbonization, a fact due to the greater amount of heat absorbed by the greater volume of their product; and in the same way, as a matter of both inference and fact, even the very driest woods drag down the heats very rapidly. It was found that an addition of only 7 per cent. of the weight of the most advantageous charge would in 12 hours run down the heats so completely as to render them unfit for work.

It required close watching for many weeks to settle the point that 375 lbs. charged every hour and a half in two benches of threes (or 62½ lbs. per retort) gave the best results; and this allowance, after being once established, was kept uniform during the 3½ years of operation. When the amount sent out was to be reduced, charges were omitted entirely, but the weight per retort per charge was never varied.

But it was also found that when the wood was split too fine, the product went off in a puff up the stand pipe mainly as condensable vapor—the rapidity of evolution affording insufficient time for conversion into true or fixed gases against the hot interior surfaces of the retort. Strangely enough, it took us longer to ascertain and correct this tendency than to counter any other unfavorable peculiarity of this substituted method. Sticks of about 16 square inches in cross sections gave us the best results—anything larger being too difficult to work off, and smaller ones giving us a reduced yield of gas with more tar. Accordingly this size was preserved in splitting—the little charges being, as a matter of course, thrown well to the back of the retort, the settings of which were arranged to throw the heat well to the front.

For every cord of wood carbonized another cord was used for fireing, the same wood being used for both purposes, except that the best sticks were reserved to go into the retorts. Occasionally a whole train load would be set aside for either gas making or fuel, on account of its uniformity of richness or poverty in resin.

Even in Georgia, the best quality of lightwood was not easily procured upon the seaboard, and every effort was made to use common pine in the fires; but the conclusion was that the lightwood was much cheaper in the end, in spite of its greater original first cost. The gas companies in Augusta, Charleston and Wilmington differed from us, however, on this point—perhaps on account of some difference in the respective prices paid for the different classes of wood.

It required 7 minutes to draw and charge the 6 retorts, and yet the make from 375 pounds of wood during the first half hour from the slackening of the lids was 2,200 cubic feet; during the second, 1,000 cubic feet, and during the third 550 cubic feet. The stand pipes were only 4 inches and the hydraulic main 13 inches in diameter, but we managed to keep everything going without much trouble, and never had a stoppage between the hydraulic main and the consumers' burners.

For some time we put faith in the statement that low heats were to be preferred, and were accordingly annoyed by the stoppage of stand pipes every eight or ten hours, a low yield of poor gas. the frequent flooding of drips at the gas holders and in the streets, and a very heavy item of gas unaccounted for. All these disappeared as we improved the settings and the methods of firing and charging, until the process became actually superior, so far as the comfort of operatives and general economy were concerned, to the coal gas manufacture.

We had, fortunately, the means of ascertaining the candle power with some accuracy, and found it to range from 16 to 22 candles, according to the condition of our lime supply. In turning on a box of clean lime the yield fell off at once from 14 to 16 per cent. Every effort was made to keep down the high percentage of carbonic acid, but the sinuous channel ways of the Savannah River delta, from which we had previously secured ample supplies of oyster shells, were blocked by torpedoes, gunboats, monitors and picket barges; and stone lime could not be transported from the distant quarries of northwestern Georgia, Alabama and Tennessee. The lightwood gas, however, required far less lime than the wood gas made in the Philadelphia works, and we managed to get a scanty supply of shells. During the last two years of the war we used a bushel of lime to 12,000 cubic feet, and the gas gave very good satisfaction.

The gas holders gave two-tenths of an inch more pressure than when storing coal gas, and the street loss rose from 7 per cent. with coal gas to nearly 14 per cent. with that from wood, calculated upon the volume sent out. It so happened that two temporary discontinuances of the public lighting enabled us to make this comparison very accurately.

We saved and sold the tar and charcoal, but the wood vinegar ran to waste, a constant flow of water being passed through the hydraulic main.

King's Treatise speaks of the curious habit of resin gas, especially noticeable when used to enrich other gas of lower illuminating power containing alkaline hydrates, of forming a viscid deposit on the interior surfaces of pipes and fittings through which the mixed gases are passed. This is produced by the combination of the resin vapor with the alkaline hydrates to form a peculiar buttery compound, which again has the power of absorbing from the gas with which it is in contact many times its own bulk of gaseous hydrocarbides upon which the illuminating character of gas depends. Hence the disappointment which has always followed attempts to use resin gas as an enricher in permanent working.

No symptom of the sort, however, occurred in our Savannah experience with lightwood gas. Our meters were wet, excepting that perhaps 150 of them were dry meters of Croll & Glover's make, and the burners were metal tipped, of which the fishtail orifices were roughly enlarged by boring out, and the batswings with a saw; yet we had absolutely no deposit thrown down in our mains, services and fittings, no noticeable stoppage or obstruction of consumers' meters, and no clogging of the burner openings.

An effort was made some five or six years ago by a Cuban engineer, named, I think, Toraya, to introduce wood gas in a general way, and a small, private plant was erected in Philadelphia to show the beauty of the product and the value of his various devices. The unlimited supply of cheap bituminous coal, petroleum and naphtha made the venture, of course, a losing one, and it is not likely that wood gas will ever occupy any important place in our industry.

The officials of the Virginia City, Nevada, gas works were at one time desirious of lighting the adjoining town of Gold Hill, which was situated at a level 300 or 400 feet lower than the works, but expected that an exhauster, and perhaps a new distributing holder, would be necessary, and they hesitated for some months on account of the expense of the undertaking. At last they took outside advice and laid an extension of the Virginia City street mains down hill to the new district, actually getting more pressure throughout the latter, without any auxiliary appliance whatever, than they wanted. They were using the pitch pine of the Sierra Nevada, with enough of the splendid Hartley shale from Australia in addition, to keep up a tolerable illuminating value in the absence of lime purification. It is the only in-

[illegible] probably, in which carbonic acid has practically displaced the [illegible] and given an illuminating gas that travels as well down hill as up.

It was 1799 that Lebon began his experiments with wood gas, and his negotiations with Winsor based upon an exhibition in Paris in 1802 really induced the independent and laborious work of the latter, which in turn led to the formation of the Chartered Gas Company in London during the year 1804. Passing by the question of priority as between Murdoch and Lebon, in the development of gas lighting, it may be stated that the wood gas of the latter was made at so low a heat as to be mainly carbonic acid, carbonic oxide and light carburetted hydrogen, the useful tars running off to waste. Pettenkofer, about the year 1848, passed the primary product from a retort worked at low temperature through a range of red-hot pipes, and may be considered the father of wood gas as a practical process. Reissig shows a quadrangular retort with decomposing cells above and below the chamber which receives the charge of wood.

Next came the substitution of large converting retorts worked at high heats instead of Pettenkofer's restricted pipes, in connection with the retorts of carbonization, and lastly came the use of a dry room in which most of the natural moisture of the wood was removed before charging the retorts—these last being highly heated, lightly charged, and so increased in size as to afford large interior converting surface.

Pettenkofer also proposed the passage of the gas from one charge of wood over the residuary incandescent charcoal of the preceding one, so as to reduce the carbonic acid to carbonic oxide. A modification of this method was employed by Professor Wilkinson in the works of the Mutual Gas Light Company of New York City, through retorts being employed, and the charcoal of each charge being successively pushed back toward the stand pipe to make room for the wood of the next one. Over 50,000 cubic feet of a non-illuminating gas was thus obtained from a cord of common pine weighing 3,300 lbs., the carbonic acid being cut down from 25 or 30 per cent. to about 10 per cent.

The conditions of coal supply as compared with that of wood induced an extended use of wood gas in Russia, Switzerland and Germany; its use in the latter country being so largely due to the many improvements of Mr. L. A. Reidinger that he is fairly entitled to divide its honors with its original discoverers. Among the many Continental towns lighted with wood gas were Bayreuth, Coburg, Wurtzburg, Darmstadt, Kempten, Regensburg, Aaren, Landshut, Zurich, Giessen, St. Gallen, Ulm, Erlangen, Luzerne, Saltzburg, Innspruck, Passen, Rentlingen, Heilbronus, Trient, Solothurn, Augsburg, Munich, etc.

In some of these the product was enriched with gas from Boghead shale, grease, etc.; while in others the quality of gas from the firs of the great forest of Hagenau was found satisfactory to the consumers without the use of any enriching material.

Up to the year 1882 a number of the smaller towns on the Pacific slope of our own country were lighted with wood gas—among them Virginia City, Nevada; Grass Valley, Oroville, Chico, Red Bluff, etc. Australian shale found great favor among them as an enricher soon after its importation began and before the development of California petroleum.

With the various modes of applying petroleum to the purposes of gas lighting, wood gas can never occupy any very important field in this country, though it would seem that in certain localities there must exist peculiarly cheap conditions of wood supply, and difficulties of transportation as to petroleum and naphtha, which would unite to render its adoption advisable.

DISCUSSION.

MR. DUNBAR—At the Virginia City gas works I would like to know how much carbonic acid was contained in the gas, its specific gravity; also the pressure on the holder, and the illuminating power of the gas, that would enable it to be forced down 300 or 400 feet, and still give more pressure than was actually needed.

MR. SMEDBERG—The carbonic acid was between 35 and 40 per cent. The initial pressure of the holder was not over 24 or 25 tenths. You must remember that this Australian shale gave us from 70 to 80-candle gas. There was a large dose of that in it, and a tremendous percentage of carbonic acid and carbonic oxide besides.

MR. DUNBAR—What pressure did you get at the lower end of the town?

MR. SMEDBERG—I do not remember exactly, but I know that it lighted the town very satisfactorily. They lighted the down hill district as well as the up hill. They had about the same pressure in both the old and the new districts.

MR. DUNBAR—I do not see how that could be.

MR. SMEDBERG—You must remember that in the wood gas alone, in which there is 35 or 40 per cent. of carbonic acid in addition to the carbonic oxide, you get a very heavy product. As a practical fact, I know that for four or five years they lighted Gold Hill in that way.

MR. GEO. TREADWAY THOMPSON—If there was 30 or 40 per cent. of carbonic acid in the gas, what elements had you left to burn?

MR. SMEDBERG—They had an enormous dose of illuminants—in the first place from their pitch pine and next from the Australian shale.

MR. GEO. TREADWAY THOMPSON—What was the illuminating power of the gas?

MR. SMEDBERG—It was 16 or 17 candles, with a specific gravity about equal to that of atmospheric air.

illuminating power if it

that large quantity of car-

and carbon in the wood.
process. It is practically a
quantity of water contained.
the Association were voted

Final Resolutions ready to

I found a few moments ago
hompson. I was on the Com-
had to make them very short.

FINAL RESOLUTIONS.

beg leave to report that in
Gas Association are due and
for his uniform courtesy in con-
to the Secretary, for the well-
proceedings; to the authors for
consideration and digestion; and
for the successful procurement of
city, and for the substantial en-
to-morrow night.

A. E. Boardman,
I. Butterworth,
G. T. Thompson,
Committee.

report was accepted and the resolu-

I want to ask a question. Re-
chandeliers for electricity and
chandelier, a quarter-inch pipe. I
the manufacturers of combination
for us in that kind of a way. It is
are; and it may work to the detri-
this instance the casings were large
the casing and the drop. I think
and I would be very glad if the
be on the watch, and next year
been in that respect.
any experience which he can

give to Mr. Lansden, or any information with regard to the manufacture of combination gas and electric fixtures in respect to reducing the size of the gas passages?

Mr. Freese—I have seen those fixtures.

Mr. Tracy—I know a case where a three-light fixture had a quarter-inch pipe.

The President—It would be well to give this matter consideration and to let the fixture people know that we are after them.

Mr. Cathels—We are all interested in this matter. I mean to try to find a fixture that will give an equal show to gas and to electric light. The combination fixtures, as a rule, give the electric light from 50 to 75 per cent. advantage. If any manufacturer will produce a fixture that is really a combination fixture, giving equal benefit to both lights, I am sure that he will get the patronage of every gas man.

Mr. Tracy—I spoke about it to one fixture man, who said that they had to use well-insulated wire and coat it somewhere, or else a bigger casing. I told him I thought he ought to make a bigger casing.

APPOINTING COMMITTEE OF ARRANGEMENTS FOR NEXT MEETING.

The President—There is one more committee to be appointed, and, as this committee is to operate next year, and during Mr. Jenkins' Presidency, I will call Mr. Jenkins to the chair and let him appoint the committee. I have the pleasure of introducing to you Mr. E. H. Jenkins, the President of the Western Gas Association.

Mr. Jenkins—I have already made one speech this afternoon and I do not think you want me to make another. The one other committee to be appointed is the Committee of Arrangements for the meeting in Cleveland next year. In appointing this Committee I wish to say to them—and I think in doing so I voice the sentiment of every member of the Association—that we do not ask them or their city to put up for us any elaborate entertainment. We have decided to go to Cleveland without any invitation from them whatever; and they are to feel that we come there on our own responsibilities, and that if we need any entertainment we will provide it for ourselves. With that explanation I name the Committee of Arrangements as follows:

M. S. Greenough, Cleveland, O.
D. R. Warmington, Cleveland, O.
C. R Faben, Jr., Toledo, O.
Irvin Butterworth, Columbus, O.
Joseph R. Light, Dayton, O.

Is there anything else to come before the meeting? If not, I wish to say, without any solicitation whatever, in behalf of the retiring officers, that we thank you one and all for your kind attention to-day, for your earnestness in carrying forward the proceedings at our me ing, and in helping us to carry through in so short a session wh ordinarily takes the greater part of two days.

The Association then adjourned.

PROCEEDINGS

OF THE

WESTERN GAS ASSOCIATION

SEVENTEENTH ANNUAL MEETING,

HELD AT

CLEVELAND, OHIO,

May 16 and 17, 1894.

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E. H. Jenkins

PROCEEDINGS

— OF THE —

WESTERN GAS ASSOCIATION.

SEVENTEENTH ANNUAL MEETING,

— HELD AT —

HOLLENDEN HOTEL, CLEVELAND, O.

May 16th and 17th, 1894.

FIRST DAY—MORNING SESSION.

The President, Mr. E. H. Jenkins, of Columbus, Ga., called the meeting to order at 10 o'clock A.M., of Wednesday, May 16th.

MAYOR BLEE'S WORDS OF WELCOME.

THE PRESIDENT—Gentlemen, I have the pleasure of introducing to you this morning the Mayor of the City of Cleveland, who has kindly come here to say a few words to us. I have the pleasure of introducing Mayor Blee. (Applause.)

MAYOR BLEE—Mr. President, fellow citizens, and gentlemen from abroad: It gives me great pleasure to meet with you this morning, and to extend to our guests from abroad a most hearty and cordial welcome, and I trust that our people of the city of Cleveland will treat you so kindly while you are here that when you do adjourn you will adjourn to meet in the city of Cleveland in 1895. (Applause.) That we have fine hotels and a very fine city I think you will admit after you have tried the first and looked over the last, and we hope to have a little finer on your coming here each year hereafter. We have in this city a Gas Company which stands second to none, I think, in the United States. When quite a small boy I was in the railroad business, and my duty was to furuish the Gas Company with coal. The Gas Company at that time, and when it started, required one car load of coal for every two or three days. Before I left the railroad business they were using fifteen to twenty car loads per day. I have been out of the business some little time, and so I do not know how many car loads per day they are now using. I wish to state further that the relations between the city government and the Gas Company of the city of Cleveland are of the most friendly and satisfactory nature (applause), and, I think, thoroughly satisfactory to all our citizens; and if our people can teach an object lesson to this convention, I would be very glad to have them do so. While there is likely to be a good deal of oral gas generated here to-day, you cannot make real gas without coal; and so I would suggest that. after you get through with your deliberations, you extend whatever influence you have towards the coal miners and operators, that we may see if we cannot harmoniously fix up the coal deal which is now being attempted by the convention in session at Case Hall, with the view of starting our factories around this city and all over the country. We have a great many factories here which are now shut down for want of coal. It is to the interest of the working men and of the operators, as well as to the interest of the public generally, to have these factories started. While I do not wish to take up too much of your time, I do want to assure you that the city is yours, and that the Cleveland Gas Company can do as they please with it during your stay here (applause); and if my worthy friend, Mr. Greenough, needs any help I shall be very glad to aid him in any way I can. Gentlemen. I thank you. (Applause.)

The President—In behalf of the Association, I will ask Captain William Henry White to reply.

Capt. White—Mr. Mayor: I believe it was Artemas Ward who said that he preferred to go to the Episcopal Church, because when the minister jawed religion to him he could jaw back. It is one of the time-honored customs of the Association to always have something to say back. You have taken the trouble, sir. to come here, and, in your courteous manner, welcome this Association to the city of Cleveland. I am charmed to be able to say that the city, notwithstanding the general reputation of the gas man, is perfectly safe while we are here. (Laughter.) I don't believe you will find dangling on any man's chain, as he goes out, the Soldiers' Monument as a charm; nor will any member attempt to carry away the pumping station of the city. On that you may rest perfectly assured. We only ask, sir, that you will extend your courtesies a little further. You have said that the city was ours. Of course we take that as the Spaniard assures his guest—that his house and his family are yours, but you must not accept them. (Laughter.) I would like to have you kindly say to us and I ask it in behalf of the younger element of this Association—that you will say to your Chief of Police that any gentlemen wearing the badge of this Association shall be sacred from arrest either in going to or returning from the duties incident to this convention; for some of the gentlemen will need that attention. (Laughter.) I was glad to hear you say that you had spent the earlier part of your working days in the employment of a railroad company. It is not generally known that the industry which we represent is, in capitalization, second only to the great railroad industry of the United States. We are gathered together in conventions about the country, representing this enormous capital, and representing industries which extend to every city and town all over this great country; and each one of us is in charge of some great and important undertaking. These gentlemen, as you see them before you, do not, I judge, impress you as being of the class of rascals which they are usually held up to be by the public press. There is not a man here who would take your watch and chain from you, unless he did it when you were not looking. (Laughter.) They sit at their ease in the lap of luxury. They roll upon tufted beds of ease, and spend their days in plotting what their night's enjoyment shall be. They are not workmen in any sense of the word. (Laughter.) Therefore your courtesy in coming here is all the more appreciated, because we know that you will throw open the clubs and other resorts that men of that character would naturally drift to. If there is anything that the city of Cleveland wants (now that we have got here—and our friend Greenough assured us we should have police protection if we came here), or if there is anything that this Association can do in the way of administering the affairs of the city for the next three days, we pledge you, heartily and unanimously, our assistance. I say, without any further joking on the subject, that the Association does sincerely appreciate your courtesy in leaving your official duties and coming here to welcome us to this city. We knew that we would be made welcome by the Gas Company; we knew that individually we had friends here who would welcome us; but it is indeed a compliment to have the head of the municipality meet with us this morning and extend to us a hearty and fraternal greeting; and in the name of the Association I thank you for it, and assure you of our appreciation. (Applause.)

THE PRESIDENT—I wish to say to our visiting friends, and to those who have made application for membership, that we wish they would make themselves perfectly at home. We want you all to feel that you are one with us; and we shall be delighted to have you enjoy the benefits of this meeting.

On motion of Mr. Ramsdell, the reading of the minutes was dispensed with, inasmuch as they had been published; and the President appointed Messrs. W. B. Sellers, G. N. Averill and C. H. Raynor a committee to introduce visitors. These matters having been disposed of, the President read the following

ADDRESS OF THE PRESIDENT.

Gentlemen of the Western Gas Association: We have reached another milestone in the pathway of this Association. We are here to finish another chapter of its history, to review another year of its existence; a year with its record of successes and failures, a year of intense interest to the gas fraternity.

Again we renew the friendship of years, again we meet with the friends who have been true in the years past, and who we know we

that the so-called light of the future is quite an expensive luxury, and that, for an economical and thoroughly reliable source of artificial light, there is nothing equal to the illuminating gas of to-day.

The following clipping, from an editorial in one of the leading daily newspapers of a recent date, shows that the time is near when electricity and gas as illuminating agents must be weighed in the balance, and each must stand on its own merits as to cost, convenience and service rendered, and when this time comes gas companies have nothing to fear:

"It is hardly to be doubted that gas, if furnished at a fair profit to the company that produces it, is a cheaper and altogether more economical illuminant, especially for private houses, and all kinds of houses, in fact, than electricity. Incandescent lamps and arc lamps are expensive, and they deteriorate from the moment they are put in. The illuminating qualities are therefore on a rapidly declining scale. Gas, on the other hand, maintains its full illuminating qualities from the beginning; there is no sliding scale. * * * And now, coming down to the main point, gas economically produced and fairly sold is unquestionably a cheaper and altogether more satisfactory illuminant than electricity. * * * As to lighting the streets with electricity outside of the immediate center, the time has perhaps come to stop and consider. The appropriation for lighting the streets has grown enormously and out of all proportion to the growth of population, but if the people will seek to turn night into day, so to speak, by artificial means, they must pay for the luxury. In this case the cost is paid by the many for the benefit of the few. The question to be considered is whether gas at a fair price and of good quality would not be a more economical illuminant than electricity."

I consider that such articles from the leading dailies of the country show plainly that the public are inclined to place the two illuminants, gas and electricity, on their commercial basis, that each must be judged upon its actual value, and we have much to be encouraged in from such a fact. The public have found out that the light can be depended upon at all times and under all conditions, *i. e.*, gas, is a commodity that cannot be dispensed with under any circumstances.

The year just closed has been one that has tried the stability of manufacturing industries as they were never tried before. Hundreds of companies, which 12 months ago were considered at the head of the list as to amount of investment, volume of business and earning capacity, have been forced to close their factories or else very greatly limit their production, and, as a consequence, millions of capital invested in these enterprises have been placed in jeopardy and unable to make the usual return dividends to the owners. Gas undertakings have not escaped from feeling the influence of this widespread, unsettled condition of business affairs; but we can point with pride to the fact that no business has been able to carry itself through such times, fraught with so much danger, as the business we here to-day represent. No other business, manufacturing or otherwise, has been enabled to so thoroughly meet its obligations and maintain its reputation for substantial values as to volume of business and earning capacity.

Much of the ability to carry our business through in such creditable manner, and under such circumstances, is due to Gas Associations of the country. Had such an amount of business disaster swept over our country 10 or 15 years ago as has been the case during the past year, few of these companies could have carried on their business on the close margin of profit of to-day and been able to meet current obligations, let alone the paying of dividends.

Through the bringing together each year of the brightest minds devoted to our profession, and the mingling of their various ideas and experiences, the companies whose representatives have been enabled to receive the advantage of this concentration of ideas have been benefited, and such companies have had the resultant experience, not of the one individual at the head of their own plant, but rather the experience of all those with whom he was enabled to come in contact during the Association meetings. It is a significant fact, and one going to show the value of these Association meetings, that while we usually devote a part of the time each year to pleasure, yet, during the greater time devoted to business, you will find the members giving close and earnest attention to every matter presented, and showing a willingness to assist to the best of their ability in adding to the general fund of knowledge. As a result you will find that the best managed plants, and the ones which give the best returns to their owners, are the plants whose representatives are found year after year attending one or more of our Gas Associations.

The question of municipal ownership of gas works continues to agitate the public mind in various localities, and many articles on this subject have appeared in the leading magazines of the day. In many instances the writers have shown that they have given the matter careful thought and study, and that they have acquired a fair knowledge of the subject, treated from their standpoint, which generally is that of municipal control or ownership. These articles, together with numerous contributions through the daily newspapers, keep the matter continually before the public.

Coupled with this, is the almost universal demand for lower prices for gas. This latter demand is, I believe, the "gist" of the whole matter. When the public are led to believe that the price charged by the company furnishing them with artificial light is too high, the first thought is that relief can be had by placing the furnishing of such a commodity in municipal hands. It is quite easy to calculate if a company which has a franchise for this particlar line of business so conducts its affairs as to be able to pay dividends to its stockholders, that under municipal control these dividends or earnings can be saved and the public be the gainers thereby.

That gas companies who conduct their business on business principles, who keep their plants in first-class order, can manufacture and distribute gas at a less cost than if the same service were performed under municipal control, is without question with those who have given the subject careful and unprejudiced thought. The question of municipal control, or rather, as I claim, that of low-priced gas, is one which will come to every gas company sooner or later, and one it is best to be prepared for. I am a firm believer in the policy of selling the best quality of gas at the lowest possible price consistent with earning a fair dividend on the investment made.

I believe it to be the best interest of the gas companies themselves to do this. Among the recent examples of this policy, and ones that will be watched with interest by the gas companies of the country, may be mentioned those of Detroit, Mich.; Milwaukee, Wis.; Cleveland, O.; Toledo, O.; and Peoria, Ill.

The gas engineer or manager's part in this question is very plain and clear. To his efforts, to the result of his labors, must a company look to be able to meet this question when presented. If, when the time comes to meet this demand, it is found that the plant under his charge is not up with the requirements of the time; if it is found that the most rigid economies that are necessary to be practiced at the present day are not part of his management, then will his company be to that extent handicapped. If, on the other hand, the plant in his charge be found in first-class condition and ready to make and supply its product at the lowest possible price consistent with local surroundings, then his company will be able to meet any reasonable demand of the city or its citizens.

I am well aware of the fact that there are times when the demands of the public are out of all reason and void of anything like justice—when it would seem that the one prevailing idea was to wipe out of existence the company, which, after years of labor, had finally placed its affairs in a position to earn a return for money and labor spent. At such times arguments are made and claims set forth as to prices, etc., in other cities, which, while in the majority of cases are far from being facts, yet are at the time difficult for the local company to answer.

In this connection, I would suggest that this Association might appoint a commission whose duty it would be to gather together, in detailed and condensed form, full information as to the cost of manufacture and distribution of gas in the different cities, taking into consideration the population of the city, the population of the district supplied by each gas company, the cost of material, labor, etc., in manufacture and distribution, the price received for residuals, the candle power and quality of the gas supplied, the miles of mains and sizes, the number of consumers, the amount of gas sold per mile of mains, and also amount sold per meter per annum, with particular mention of the taxes of all kinds per 1,000 cubic feet of gas *sold*, and such other information as would be found valuable; this information to be corrected from year to year, and to be for the exclusive use of the members of this Association. Then, when the question of contract with a city, or in case of agitation of the question of municipal control, or, worse still, if an opposition company were trying to force its way into territory now occupied by a local company, much valuable information could be had in a very short time—information that would be of utmost importance to the gas company already in the field; and it would be in a position to answer promptly, and with facts that could not be questioned, statements that are always made by those whose sole aim seems to be to wreck a prosperous and successful company. Several instances have occurred recently where it has cost an individual company a great deal of time and money to get these data, which, if prepared as suggested, could have been obtained in a very short time, in a much more thorough manner, and with but very little trouble or expense.

There are few gas companies of to-day that do not attempt to introduce gas stoves for cooking or heating purposes, and the success attending such efforts is, in nearly every instance, according to the energy and push used in their introduction. Gas stoves do not sell themselves; it requires persistent, hard work to get them introduced, and continued efforts ever afterward to make successful sales. Gas companies must show, by their willingness to place these appliances on trial when necessary, their abiding faith in such apparatus, and it is also necessary occasionally to back up that faith with some good, hard-earned cash. Nothing tends to create confidence in the mind of a consumer more than the fact that the gas company is willing to put its money into such appliances that he may need, and will guarantee succesful results from them.

No branch of the gas business will give better returns for the amount of time and effort put forth than the fuel gas department; and one does not need to depend on the question of gas stoves alone, for he will find there are many other ways in which gas can be used for fuel purposes.

There are several manufacturers at the present time who are placing on the market stoves of almost any size and style. These manufacturers have shown a willingness to meet the demand for various kinds of apparatus, and their appliances are giving excellent results. A gas company cannot excuse itself for not pushing this branch of the business by saying it cannot find suitable apparatus. Several important improvements have been made in gas heating appliances, and results are claimed that, if true, will in a very short time solve the problem of the heating of buildings with a gaseous fuel, and that fuel the illuminating gas of to-day.

Several gas companies during the past year or more have been making a specialty of introducing a combined gas and steam heating apparatus that is placed in the room where heat is needed, and these companies report excellent results as to increased sales and the satisfaction of their customers. I am well aware that many gas engineers object to any gas stove or heater that does not have an outlet connection to a flue; but the makers of this combined gas and steam heater claim that the small quantity of gas required, and the construction of their heater, is such that the air of the room is not made injurious to health, but rather is made better by consuming the particles of dust, etc., generally found floating therein.

From a personal experience of three years with these heaters, I am convinced they are an excellent article, and their work has been perfectly satisfactory to our customers. Your Executive Committee, together with the Committee of Arrangements, have invited the manufacturers of gas appliances of all kinds to make an exhibit of the same during the present meeting. Suitable hall accommodations have been secured, very convenient for the members, and you will have an opportunity of making a careful examination of the different kinds of cooking and heating stoves, burners, etc. I trust that every member will devote as much time as possible to this display, and I am certain that everyone who does so will find such time very profitably employed.

In connection with the subject of gas appliances, I wish to call the attention of members to a new field for the use of gas—one that has scarcely been touched upon in this country as yet—gas motors for street railway service. The Messrs. Connelly, after a number of years of careful study and experiment, have recently put upon the market the Connelly motor, designed especially for street car propulsion. At first it was intended to use Pintsch gas, as the supply for the motors had to be compressed to about 150 pounds, in order to carry the amount of gas required to run a reasonable distance. Recent experiments have proven that the ordinary illuminating gas can be used. It requires about 2,000 feet of gas per day for each car, and you can readily see that they would become a valuable customer for a gas company.

The cost of equipping a street railway system with gas motors is about one-half the cost of an electric railway system, and the cost of operating the gas motors is less than the cost of operating horse cars, and considerably less than by electricity.

Another great advantage in favor of gas motors is the fact that each car is an independent motor, and an accident to one does not interfere with the working of the others in the least. This is a very important feature, and one that is greatly desired by the roads operating the trolley or cable system. From a recent article in the *Electrical Review* on "Storage Battery Traction at Washington, D.C.," I quote the following:

"Every available means to attain success was tried, and failed. The experiment has settled many vexed questions, exploded some humbugs, and will be of great value to all persons interested in street railroads. It has made it clear that, up to the present time, science and art have not produced a storage battery capable of supplying power to practically operate such roads as the Metropolitan. Still, the result does not justify absolute condemnation of storage batteries for railroad use, nor destroy hope of an independent railway motor.

"Such a motor is demanded by the public need, the inventive genius of the world is challenged to produce it, and there is a growing faith that, somewhere in the conserved forces of the universe, there is a power which shall wipe the unsightly and obstructive trolley lines off the face of the earth, shall bury the power wasting cables in their own grave, and turn the faithful car horse out to the enjoyment of green pastures and well-earned days of rest."

It is not improbable that the gas companies may yet supply this demand for an independent and economical motor.

At the regular meeting of this Association in 1892, at Detroit, a committee was appointed to revise the Constitution and By-Laws of our Association. This Committee performed their duty faithfully, and made a report at the regular meeting in Chicago last year. The Constitution presented by this Committee was read and seconded by the Association, and under our rules was laid over for one year, and now comes before you for final action. It is scarcely necessary for me to call your attention to the importance of having suitable rules for the government of such matters as may come before our Association. The Committee having this matter in hand considered that a large number of rules were not needed, but rather that the number should be small, concise in wording, and easily understood. I trust you will give this matter prompt and careful attention.

The various papers that will be presented for your consideration are upon timely and practical subjects. Comment upon these papers is not necessary. The authors selected are well known to all of you and are amply able to handle the subjects in a thorough manner.

I trust that a full and free discussion will be had upon each matter presented, for in this way we are enabled to get the greatest benefit; frequently many ideas are brought out in the discussion following the reading of a paper that were not thought of or overlooked by the author.

The "Question Box" should be a fruitful source of information, but has not had in the past the consideration it deserves. I think the reason for this lies in the fact that the questions are brought before the meeting after every other business has been disposed of, and at a time when every one seems ready for a motion to adjourn. I would suggest that the question box be opened either at the afternoon session of the first day or during the morning session of the second day, so that proper consideration can be given the questions asked.

We are promised a very valuable report from the Committee appointed to investigate the action of electric railway currents upon gas and water pipes. This Committee have given a great deal of time and attention to this subject, and the information they have been enabled to collect and prepare for this meeting will be of great benefit to its members.

In 1892, at the Boston meeting of the American Gas Light Association, a paper was read by Mr. W. R. Addicks of Boston, Mass., entitled "A Gas Association and Its Members." This paper created a great deal of interest at the time among the members of the American Gas Light Association, and was afterward referred to their Council for deliberation, and to report a plan somewhat on the line suggested by Mr. Addicks. The paper presented by Mr. Addicks has been carefully read and studied by the members of the various Gas Associations of the country since that time, and informally discussed by those members when they have met each other.

Quite naturally, a matter that was of such apparent interest to the present standing of these Associations, it being practically a federation of these organizations into one principal or National Association, with various branch or district Associations, found those who, being loyal to their own Association, looked with distrust upon anything that might destroy its individuality.

At the 1893 meeting of the American Gas Light Association the subject of "Federation of the Gas Associations," as it was by that time more commonly called, was again brought before that body, and a special committee, with Mr. W. R. Addicks as Chairman, was appointed to further consider the proposed scheme. This Committee have had the matter under careful consideration since that time, and have revised the original proposition in many particulars. They have requested that committees be appointed from the different Gas Associations, and that this general committee meet just before our present meeting in order to fully consider the matter as revised.

At the request of the original Committee, your President appointed Messrs. Geo. G. Ramsdell, A. W. Littleton and B. E. Chollar as a Committee to represent the Western Gas Association at this general committee meeting. It is expected that this matter of Federation will be reported to the Western Gas Association, for action at its present meeting, and its general plan comprises:

1st. That steps towards standards shall be adopted by all Associations.

2d. A system of papers and discussions upon the same topics shall systematically be taken up in the various conventions.

3d. A uniform plan of publication of papers and proceedings in a quarterly magazine.

The Committee expect to be able to report in detail the probable expenditure and income of this last section. The fact that this matter comes first before the Western Gas Association makes it a very important one, and I trust that it will have careful consideration and be free from any hasty action.

Gentlemen, I thank you for the honor you have conferred upon me by selecting me to preside at this meeting. I shall endeavor to discharge the duties imposed upon me to the best of my ability, but the success of our meeting does not devolve upon the President; its success depends entirely with each and every individual member. May each one of us, when the time comes for us to depart for our homes, feel that it was profitable and pleasant for us to have been here.

This meeting is now in your hands.

The President announced the next thing in order would be the

REPORT OF BOARD OF DIRECTORS,

which the Secretary read as follws:

Cleveland, O., May 15, 1894.

A regular annual meeting of the Board of Directors of the Western Gas Association was held this morning, at 10 o'clock, at the Hollenden, Cleveland, O., with the following members present: E. H. Jenkins, I. C. Baxter, Wm. McDonald, Jas. Ferrier, Geo. T. Thompson, B. A. Ward, A. W. Littleton. The chair was occupied by E. H. Jenkins, and A. W. Littleton served as Secretary.

On motion of Mr. Ward, the reading of the minutes of the last meeting of the Directors was dispensed with.

The Board examined the following papers, which have been prepared for presentation at the Seventeenth Annual Meeting of this Association, and, on motion of Mr. Baxter, it was ordered that the same be read in due course:

"Three Years in a Country Gas Works," by S. M. Highlands.

"How to Make Small Electric Light Plants Pay," by I. C. Copley.

"Influence of Temperature on Purification," by Jas. Ferrier.

"Some of the Advantages of Oil Gas Works for Small Towns," by J. W. Stratton.

"Street Main Pressure," by Irvin Butterworth.

"History of the Gas Meter," by William McDonald.

"Best Method of Introducing Gas Stoves," by H. Wilkiemeyer.

"Wrinkle Department," by George T. Thompson.

"Report of the Committee on Electrolysis."

The Board appointed Messrs. I. C. Baxter, B. A. Ward and B. E. Chollar a committee to audit the accounts and examine the books of the Secretary-Treasurer, and report thereon to the Association.

Messrs. William McDonald, James Ferrier and George T. Thompson were appointed to examine and report on applications for membership.

On motion of Mr. Thompson, it was unanimously ordered that the Board of Directors recommend to the Association that the new Constitution and By-Laws, submitted at our Chicago meeting of 1893, be adopted at our forthcoming meeting; and if it should be the desire of any of our members that alterations or amendments should be made thereto, that the same be presented at this meeting for consideration one year hence.

On motion of Mr. Ferrier, it was carried that the Board recommend to the Association that the business sessions of the convention shall be called to order at 9:30 A.M. and 2 o'clock P.M., and that this announcement shall be duly made on the bulletin board in the hotel office.

The Board further recommended that at 11:30, on the morning of the first day of the meeting, the Association shall adjourn to visit in a body the exhibit of gas appliances, which has been prepared for our instruction and entertainment.

On motion, the Board here adjourned, to reconvene at the call of the President. A. W. LITTLETON, Secretary.

THE PRESIDENT—You have the report of the Board of Directors before you. What will you do with it?

MR. SOMERVILLE moved that the report be received and adopted, and the President, in answer to a question by Mr. Lansden, having said that the adoption of the report would mean the adoption of the new Constitution and By-Laws, the motion to adopt prevailed.

APPOINTING THE SPECIAL COMMITTEES.

THE PRESIDENT named the following committees:

ON PRESIDENT'S ADDRESS—I. C. Baxter, James Somerville and B. E. Chollar.

ON NOMINATION OF OFFICERS—George G. Ramsdell, Charles R. Faben, Jr., J. B. Howard, J. T. Lynn and W. L. Brown.

ON PLACE OF NEXT MEETING—E. G. Cowdery, Robert Young, Joseph Gwynn, H. W. Douglas and George T. Thompson.

ON MEMORIALS—Thomas G. Lansden, F. W. Freese and W. M. Eaton.

THE PRESIDENT having said that although applications for membership would go over until to-morrow, all those who made application should consider themselves entitled to take part in the sessions, and then called for the

REPORT OF THE SECRETARY-TREASURER,

which was read by Mr. Baxter, of the Auditing Committee:

QUINCY, ILLS., May 1, 1894.

Receipts.

To membership fees	$ 100 00	
" dues	854 00	
" sale of badges	38 00	
" balance from May 1, 1893	341 21	
		$1,333 21

Disbursements.

By Secretary's salary..............	$ 400 00	
" sundry bills, as per vouchers.....	537 40	
" bal., cash on hand, May 1, 1894..	395 81	
		$1,333 21

Approved by Auditing Committee,
ISAAC C. BAXTER,
B. A. WARD.

On motion of Mr. Odiorne, the report was received and placed on file.

A GREETING FROM THE PACIFIC COAST ASSOCIATION.

The Secretary read the following telegram:

SACRAMENTO, CAL., May 15, 1894.

To A. W. LITTLETON, Secretary Western Gas Association, Hollenden House, Cleveland, Ohio:

The infant, the Pacific Coast Gas Association, meeting to-day, sends greeting to the Western Gas Association.

JOHN A. BRITTON, Sec.

On motion of Mr. Somerville, seconded by Mr. Gwynn, the Secretary was instructed to send a greeting from this Association to the meeting of "The Infant."

REPORT FROM COMMITTEE ON REVISION OF CONSTITUTION AND BY-LAWS.

THE PRESIDENT—The next thing on the programme is reports from standing committees. The report from the Committee on Constitution and By-Laws ought properly to come before the meeting, and the new Constitution and By-Laws be read. Although we have practically adopted it already, yet I think we ought to know exactly what there is in the new measure. I will, therefore, ask the Chairman of the Committee, Mr. Ramsdell, to read it.

[Mr. Ramsdell then read the Constitution and By-Laws submitted at the last annual meeting, for which see page 177 of this volume.]

MR. RAMSDELL—I move the adoption of the Constitution and By-Laws.

THE PRESIDENT—You have heard the reading of the Constitution and By-Laws, and the motion of Mr. Ramsdell. The matter comes up now for final adoption. The report was carefully considered by the Committee a year ago, referred to the Committee to report thereon at this time, and the recommendation of the Board of Directors that it be adopted as read has been acted upon. If any further amendments are proposed at the present time the matter would have to lie over another twelve months.

MR. LANSDEN—I understood that the Constitution was adopted before it was read.

The President—It practically was adopted by the resolution adopting the report of the Board of Directors; but I felt that in fairness to the members here, and so that there might not be any snap judgment about it, the Constitution and By-Laws should be read. If this motion by Mr. Ramsdell goes through it stands just as it did before, or you can amend it at any time during this meeting; but proposed amendments would have to lie over. If there is no further discussion desired I will put the question. (The motion prevailed; and on motion of Mr. Cowdery, seconded by Mr. Baxter, the Committee was discharged with the thanks of the Association.)

The President—The recommendation of the Board of Directors is that we attend in a body the exhibit of gas appliances to-day. The time for adjournment for that purpose is nearly at hand, but as we have about 20 minutes yet, I would suggest the Secretary read one or two of the questions from the Question Box, so that the time may be profitably occupied.

The Secretary—The first question is:

1. "*Where can one get market quotations on coal tar?*"

The President—That is an important question to most of us, as the price of coal tar is a subject we are all interested in, and if there is any place where we can get market quotations on coal tar we shall be glad to hear of it; if not, we shall be glad to know why not.

Mr. Odiorne—The question is rather vague, because there are different qualities of coal tar. There is the imported tar and a tar produced by the blast furnaces in this country, besides the staple tars resulting from the manufacture of coal and water gas. Therefore I think it would be rather hard to answer the question. The headquarters for the Western tar, I think, is the S. E. Barrett Manufacturing Company, of Chicago, who handle a large proportion of it.

The President—Can anyone else give us any information in the matter? If not, the Secretary will read the next question—

2. "*Has any member had experience with electrical apparatus for gas lighting? If so, was it a success or a failure?*"

Mr. Russell—Does that refer to house lighting?

The President—One would naturally suppose it referred to all cases of lighting gas by electricity.

Mr. Russell—I have had some experience in house lighting. I do not think it would apply to street lighting and be much of a success. Naturally it is necessary to use primary batteries for that; and if a man has much of a district to cover I do not think he could well use electricity for lighting purposes, because I think the lamps could be better lighted with the ordinary torch.

The President—What has been your experience in house lighting?

Mr. Russell—With house lighting, where the wiring is properly put in, and where the equipment is perfect, as far as I know or have heard, electricity can be operated very successfully. There are a number of electrical concerns which have electric gas lighting appliances, and any one of them will do it.

THE PRESIDENT—What is the smallest number of burners in a house which could be practically fitted up with an electrical apparatus for lighting purposes?

MR. RUSSELL—Do you mean in one chandelier?

THE PRESIDENT—How many in a house?

MR. RUSSELL—In a house having 60 or 70 jets it can be put in very cheaply. I would suggest, however, that each room be fitted for the purpose separately. I do not think that one set of batteries and wires will work very successfully for all the rooms in a house. It would be a good thing to put those up in series; and if the wires are made sufficiently large to carry the current they will not be overtaxed. If you overtax a wire, I do not care whether with dynamic electricity or with static electricity, there is bound to be a bad result. That is where the great trouble is had. Everybody tries to put things in too cheaply. The wires are too small, and therefore they do not give good results. Another thing, the batteries are very seldom properly looked after. In a town where there is no one who makes a business of wiring up houses, and no one to look after the batteries, there is some trouble probable; but if one has a proper installation, and will take care of the wires and batteries, I think it will pay him to use electricity for lighting purposes.

MR. HIGHLANDS—As I have had some experience with house lighting by electricity, it may be of advantage to some one if I contribute an answer to that question. As you probably know, we keep a corps of electric wire men, and have to devote a little attention to house lighting by electricity. We find that our customers are well pleased with it, and that it is possible to wire a house and to light it by gas just as advantageously, and that it is as easily handled as when lighting by incandescent lamps. We wire the rooms separately—the halls and bedrooms. There are appliances for lighting the gas, just as you put in switches for turning on the incandescent lamps. We have probably 25 or 30 houses, with from 6 to 30 rooms each, that are now using it, and no one of those parties cares to use the incandescent lights in preference to gas, because they now have all the advantages of incandescent lamps with none of the disadvanges and at less expense. I am not technical enough to answer the question fully as to just how the wiring is done, but if any person cares to have the information I will forward it to him without any expense whatever. It can be made very convenient and very successful, and there is no expense to operate it except the little expense for renewal of batteries.

MR. BUTTERWORTH—If Mr. Cline, of Springfield, O., were here he could tell you what he has told me, that in Springfield the Public Library is lighted with gas, equipped for electric lighting, and that it is very satisfactorily done and is very successful indeed.

Mr. McIlhenny—It is not only important to the gas people to make the use of gas as effective and as convenient as possible, but to every one who burns gas this is one of the greatest conveniences which you can possibly imagine. I put it into my own house and I would not be without it for anything. It is a great convenience and comfort to be able, when you are in bed, by simply touching a button, to light up your halls and rooms, so that if a burglar happens to come in you at once have decidedly the advantage of him, for he would be very much astonished. In that way I consider it not only a great convenience, but a very great safeguard. It is quite as convenient as electric incandescent lighting. You have simply to go to the wall and touch a button, and your chandelier is lighted. It is all done quickly. No matches are required. I think anyone who burns gas—not only the gas makers but all who use it—ought to encourage everything which makes gas attractive. We ought to put the device in wherever we can. I have been surprised at the small cost. The man who attends to the batteries does it for a dollar or two a year; for they do not really require any great attention.

Mr. Penn—I have my house lit up with an electric gas lighting apparatus, but I use a storage battery, and think it is much better than other forms of battery. The other batteries are continually getting out of repair or running down; but a storage battery will last almost indefinitely. I would not be without the apparatus in my house for three times the cost of it. I consider it just as convenient as incandescent electric lighting.

Mr. Odiorne—What is the expense of the storage battery?

Mr. Penn—The battery which I use cost me $9 per cell; and as I run my own electric light plant I fill it myself.

Mr. Somerville—I understand you can light the gas with electricity, but I have not yet understood that you could turn it off in the same way. I wish some of the gentlemen who use it would describe in a few words the modus operandi. How is it turned on, and how is it turned off? Give us some idea how it is operated. I am sure Mr. McIlhenny can tell us how it is done, and I hope he will enlighten others, who may be ignorant, like myself, about it.

The President—Can anybody give Mr. Somerville that information? It is a matter that we are all interested in.

Mr. McIlhenny—I really do not understand the construction of the wires for the electrical appliances; but to turn it on or off we simply press a key, one end of which is black and the other white. When turning it on the white end of the key is pressed, and when shutting it off the black end of the same key is pressed. The key swings on a hinge in the middle, and both ends are equally prompt in performing their duty.

The President—Do you turn the gas on and light it at the same time by simply pressing the button?

Mr. McIlhenny—Yes; the same key does both. Pressing the white end of the button turns the gas on and lights it; pressing the black end shuts the gas off as effectually as the other end lights it.

Mr. Highlands—A further advantage I think of is: We have in our city a lamp post in front of a house, probably 300 feet from the house. Three years ago that was also connected up with electric wires so that the lamp on the post could be lighted from the house. It has never since required any attention, but has been turned on and off from the hall of the house every night and morning since. How much further that system can be carried is simply a question of battery power. This lamp is controlled entirely from the battery—which is a dry battery and not a storage battery. The question of the strength of the battery is, of course, a simple matter. By adding to the cells of the battery, and thus simply increasing the voltage, you can carry its effect as far as you see fit, but of course increasing the voltage will increase the expense of the battery. In installing these at first we agreed to keep them in repair free of expense to the consumer—they paying for the installation. A complete installation for 100 burners would cost about $125, put up with a wire strong enough, and well enough insulated, to be practically indestructible; so that outside of the expense of renewing the battery, and the cost of the wiring itself, there should be no expense for years. The results have been very satisfactory wherever we have installed the apparatus. The only question at any time has been the expense of installation. It costs just about the same to wire up for the gas lighting that it does to wire up for the same number of incandescent lamps, and it is equally indestructible.

Mr. Harbison—I think the writer of that question must have had in mind the idea of the practicability of ordinary house lighting by the use of electricity. But in listening to the gentlemen who have spoken on the subject I have not observed that any of them have given any indication as to whether, for instance in this room, where there are 24 burners on the chandelier, and it was desired to light only one or two burners on each chandelier, or on any one of them, it can be done separately, or whether all the burners must be lighted. It seems to me that this is the practical point. We all have a great many more gas jets in our houses than we want to use all the time. Can the servant, in going around at lighting time, light as many burners as may be required by simply pressing a button, or must all the jets be lighted, and then go around and turn off a certain number? Will some one who has had experience tell us a little more definitely with regard to that, and whether it is practicable to so arrange it?

Mr. Highlands—In answer to that question, the burners are put on wires in series, and the current going first to one, follows right through the series; and when you turn it on by pressing the button it will light all the burners in that series. If you wish to light but one or two burners you must have a separate wire for those one or two burners.

The President—You can readily see how we can make the question box a very profitable institution if we try. We have one more question which may be answered before the recess:

3. "*A gas works has a holder located a block away from the plant. How can the movement of the holder be best indicated in the office?*"

Will some one answer that question? If Mr. Joseph Light is in the room I think he can answer it.

Mr. George Light—Joseph Light is not here, but I think I can answer that question. It is done by a wire run from the holder, and then simply reduced by pulleys into a dial. We have had that device in use for eight years, and have never had any trouble with it. Its operation is entirely satisfactory. It is done on the relief holder of a water gas plant, to tell the water gas man what he is making. The scale is divided up as low as 500 feet.

Mr. Thompson—Has Mr. Light ever had any difficulty with that attachment because of sleet?

Mr. Light—Never.

Mr. Harper—Some time ago I saw a very useful plan of that kind in the case of a New York company. It was arranged something like a switch board for a number of incandescent lamps. The lamps were of different color, and indicated by the color the height of the holder. Upon every movement of the holder the lamps would put themselves in evidence at once. It struck me as being a peculiarly complete way of getting over the difficulty.

Mr. Thompson—I have seen another manner of indicating the height of movement of the holder, but not in this country—I wish to ask if any member knows of its being applied in America?—that consists of a large bowl carried on the crown of the holder, at the edge, from which a pipe carries a stream of glycerine through an underground pipe to a gauge at a convenient point in the office. The large bowl is of so much greater size and capacity than the pipe itself, that the height of the holder cuts very little figure in the height of the liquid in the bowl; but the pressure due to that additional height is so considerable that a delicate gauge would perfectly indicate every movement of the holder. That gauge was applied at a distance of over 300 feet from the holder.

Mr. Highlands—I do not believe that a gas man should be very much of an advocate of the use of electricity, neither should he entirely ignore it; but the question of harnessing it and putting it where it can do your work easily, conveniently and cheaply, comes up so frequently in gas works that I do not think we can properly ignore it. I wish simply to say, regarding an apparatus of that kind to be put up cheaply, I would use the ordinary house bell attachment which we put up in our kitchens to show the locations of the rooms in the house, and I would put a wire with necessary attachments on a column of the holder and let the holder make a contact with that. It would cost, probably, $5 to put it up, and then would cost nothing to keep it in order.

The Association then took a recess until 2 o'clock P.M., and the members in a body visited the exhibit of gas appliances.

FIRST DAY—AFTERNOON SESSION.

REPORT OF COMMITTEE ON NOMINATION OF OFFICERS.

MR. RAMSDELL—Your Committee on the Nomination of Officers begs leave to submit the following report:

President—T. C. Baxter, Detroit, Mich.

First Vice-President—W. H. Odiorne, Springfield, Ills.

Second Vice-President—S. M. Highlands, Clinton, Ia.

Secretary and Treasurer—J. W. Dunbar, New Albany, Ind.

Directors—E. H. Jenkins, Columbus, Ga.; J. W. Stratton, Valparaiso, Ind.; William McDonald, Albany, N. Y.; Geo. T. Thompson, St. Louis, Mo.; Irvin Butterworth, Columbus, O.; William M. Eaton, Jackson, Mich.; Robert Young, Allegheny City, Pa.; James Forbes, Chattanooga, Tenn.; H. Merrill, Janesville, Wis.

I wish to say to the members of the Association, with regard to the nomination for Secretary-Treasurer, that your Committee has exhausted every effort that it was capable of using in the endeavor to continue Mr. Littleton in that office. We all know that he has been an exceedingly and unusually faithful officer, that he has been untiring in his loyalty to the Association, and in the courtesy of his treatment of the members. I know you will all feel with me a keen regret that Mr. Littleton leaves the position which he has so long held; but he has given the Committee satisfactory reasons why he should be relieved at this time, and the Commtttee has had no other course, therefore, than to select a gentleman who will, I think, meet with your approbation, as his selection met with the approbation of the Committee.

ELECTION OF OFFICERS.

On motion of Mr. Ramsdell, seconded by Mr. Littleton, Mr. Geo. T. Thompson was instructed to cast the ballot of the Association for the election of the nominees; and having done so they were declared by the President to be duly elected as officers for the ensuing year.

MR. SOMERVILLE—Mr. President, I don't much like this sort of thing. Is it not possible to induce our Secretary to continue in office? We members are taken very much by surprise. The thing has been done so quickly that I almost wish we could reconsider the motion.

THE PRESIDENT—It is of course rulable to move to reconsider.

MR. SOMERVILLE—I don't know whether it would be of any use to make that motion; but if it can be done I think something certainly ought to be done or said in recognition of the long, faithful and efficient service of our esteemed and worthy Secretary, Mr. Littleton. I hate to part with him in this way. I am not good enough speaker to say what I would like to say about it

THE PRESIDENT—I will say that the Chair is here to execute the wishes of the meeting. I confess I am quite as much taken by surprise as other members seem to have been. I am ready to entertain any motion you wish to make.

MR. RAMSDELL—I might say in connection with this matter that Mr. Littleton has no warmer friend in the room than I am This matter was brought to my attention two months ago. I was then pledged to secrecy about it. After exhausting every argument I could bring to bear upon him, and trying in every way to get Mr. Littleton to reconsider his decision, I finally agreed to take the course I have just taken, for I know from what Mr. Littleton has told me that it would be impossible for him to continue in the office. I think it would be not only well, but there should be a Committee appointed to prepare suitable resolutions expressing our respect and confidence in Mr. Littleton. At the same time I think it would be quite useless for us to try to change him in the decision which he has made.

MR. DUNBAR—I move that a Committee be appointed to prepare a set of resolutions expressive of our appreciation of the services of our retiring Secretary-Treasurer.

The motion was carried and the President subsequently appointed as such Committee: J. B. Howard, B. E. Chollar and C. R. Faben, Jr.

REPORT OF THE COMMITTEE ON ELECTROLYSIS.

Mr. Geo. Treadway Thompson, Chairman of the Committee on Electrolysis, read the following report:

Your Committee, to whom was referred the matter of electrolytic corrosion of gas and water pipes by the return currents of electrical street railways, submit the following report as the results of their investigations:

A thorough appreciation of the principles of electrolysis being necessary to the proper explanation of the effects observed, your committee may be pardoned for repeating some details which may be already familiar. Practical employment of the phenomenon of electrolysis is made in electro-plating, in the Edison electric meter, in the reduction of aluminum and other metals from their oxides, in the purification of sewage, etc.; but the condition of its application most similar to that which we are now considering is exhibited in the well-known laboratory experiment of analyzing water by the passage of an electric current between poles immersed in the acidulated liquid, for elec-

now a full agreement by both the owners of the buried pipe and wire systems and the street railway people as to the cause of the trouble, all uniting in ascribing it to the earth returns of the enormous currents used in electric traction.

Having agreed that the grounded current is responsible for the injuries we have observed, let us see the manner in which it acts. No effect is produced where the current reaches the pipes, for this is a negative electrode, and would be receiving a deposit from the rails and bond-wires, if any action were apparent. Neither is there likely to be any damage in the body of the pipe, unless a small connecting line should be encountered whose greater resistance would cause heating, or the presence of joints of higher resistance (due to leaks, or the use of cement) should force the current out, to return a few inches further on. But the injurious action occurs at the point where the current *leaves* the pipes to enter some conductor offering an easier path. This will usually take place opposite the power-house—where the current is also greatest in quantity owing to the accumulated returns from the entire line—and at points where pipes cross beneath the tracks, the current returning to the rails with especial readiness if the direction of the pipes no longer coincides with that of the railway. Here the conditions of our laboratory experiment are reproduced. Of two points where rails and pipes are equally distant, the greater flow of current will take place where the greater moisture exists. This moist earth then is our electrolyte, made specially effective by the gas, ammonia from animal refuse, salt from melting snow, or other chemicals present in the ground; the pipe is our anode; and the rail or other objective point of the current the cathode. The metal of the anode or positive pole is gradually carried in the direction of flow* of the current; and the electrolysis once begun, the oxygen and ozone of the electrolyzed moisture collect at the positive pole and aid in attacking the pipe. The rapidity of its destruction depends on the quantity of current passing rather than upon its voltage; and instances are on record and in the knowledge of your Committee where a single month sufficed to destroy new service pipes.

Verbal expressions from several sources, as well as certain published discussions, seem to indicate that the full extent and effect of this electrolytic trouble is but vaguely realized by many of us. Some of us may think that not having found any ill effects ourselves, the question, though an interesting one, deals with a matter that does not touch *us* directly. Your Committee would emphasize this statement, that no city in which an electric road is operating with any part of the return through the ground, has its gas and water pipes wholly free from electrolytic action; the [illegible] [illegible] is due [illegible] to incomplete information. To draw attention to the wide-spread nature of the trouble, a portion of the appendix accompanying this report is devoted to published accounts of damaged pipes. The greater number of complaints come from the water interests, for two reasons: first, greater conductivity, for the water mains range greater in size than gas mains, the absence of cement joints decreases their resistance, and the contained water may add to the conductivity; and second, the greater pressure carried more quickly accomplishes a leak. But the gas mains are beginning to indicate the action upon them, and will do so more and more unless effective remedies are soon applied. When we realize not alone the immense capital buried in our water and gas distributing systems, but the fact that street improvements have made repairs to our pipes additionally expensive, we may begin to appreciate the serious character of a condition which divides by 5, 10, 50, and even 100, the life of a pipe, and which, until the cause be removed, may repeat the operation on the replaced line in an equally short time, or accomplish a similar injury at another point where its action will be less readily located.

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*Mr. Allyn's account of the coating of a gas-pipe by lead electrolytically deposited from a water service will be found in the proceedings New Eng. Assn. Gas Engnrs., Am. Gas Lt. Journal, Mch. 12, '94, p. 364.

Coming now to a consideration of the remedies, we will first notice those which have been suggested for adoption by the gas and water companies. Probably the earliest of these was that of coating the pipes with non-conducting paint or a covering of similar purpose. A parallel of this is the use of drain pipes of slightly greater diameter than the metal ones, slipped over the latter and cemented at the joints and at ends. These have been adopted with especial convenience for service pipes crossing under the rails, but their value is dependent upon the local circumstances. If the corrosion at such a place is caused by the current flowing downward through the earth and so entering and leaving the service at about the same points—placing it in an electric bath, as it were—such a covering should prove a true protection. But if the current had reached the line through some imperfection at a point further away, and caused the corrosion by leaving the pipe to return to the rail, any insulation, if locally effective, would cause the current to seek a different avenue of exit and so merely transfer the point of corrosion. A determination at such places of the direction of the current, whether from or to the rail, would show whether or not a non-conducting covering would be effective. Incidentally, the adoption of insulation at the current's points of departure would increase the resistance of the mains and so decrease the proportion of current carried, but complete relief by the plan suggested would require encasing of the entire distributing system, and as a final curative it may be dismissed as impracticable.

The same reasoning applies to the method adopted on certain lines of water pipe in Los Angeles, which were laid in conduits filled with sawdust, and also to the use which has elsewhere been made of a covering of pitch, kept in place by boxing of convenient form. All these protectives are too costly for general adoption, and no partial installation of any of them would wholly cure the trouble.

A similar statement may be made regarding the device of winding or protecting the pipes with copper wires attached to plates buried below. This was tried in Cambridge, Mass., but relinquished because of the rapid destruction of the copper ground-plates.

The paralleling of gas mains on each side of streets occupied by electric roads, that there may be no crossing service pipes, has been suggested; and in Aurora, Ill., circumstances have left the Gas Light Company with their mains thus duplicated, and hitherto no trouble from electricity has been experienced. But it would seem that while crossing mains at intersecting streets could be insulated, some electric leakage or induction must occur from the long parallel lines of uninsulated conductors, rails and pipes, thus placed comparatively close together. The British Committee on the electrolytic subject seem to regard the interposition of six feet of dry earth as a sufficient shield, but under the conditions existing in most cities the absence of moisture would be difficult to guarantee; and the great cost of such a method of protection, even if effective, would put it out of the question.

The use of cement joints for gas mains is in a measure an advantage as a protection, for any tendency to increase the resistance of our pipes is helpful so far as it goes. This remedy though does not apply to the water mains; and should the pipes have been connected to the dynamos or cross-bonded to the rails, as will be described later, the presence of cement joints would be a positive source of danger.

It is plainly apparent from a consideration of the foregoing devices and the conditions which limit them, that no remedy can be applied by the gas and water interests which will be wholly effective. We now come to consider the preventives whose adoption devolves upon the railway companies.

In the earlier days of the "broomstick trains," the practice as to current direction was not as uniform as it generally is now, for in some plants the dynamos were run with the positive pole to the trolley wire, and some with the negative. In the latter cases, electrolytic effects were produced along the entire line wherever the current would find a ready path from pipes to rails, so that locating the injuries was a much more difficult task. As the car motors take current either way, however, reversing the current's direction was an easy matter—especially in places where but one electric road is operating—and has been very generally done; the liability to corrosion is thus brought to within a narrower range, and largely localized in the neighborhood of the power-houses.

Most prominent in point of number among the remedial devices adopted by the railway companies are those for securing additional electrical contact at the bonds, and obtaining a bond conductivity approximately equal to that of the rail itself. The necessity of greater attention to this latter point is shown in the tables which have been published of relative conductive areas of the several sizes of rails and bonds in use; it has been customary to bond 56-lb. rails, for instance, with No. 0 B.W.G. copper wire, whose relative conductivity is but one-twentieth as great. The use of the customary sizes of supplementary wires between the rails is by this comparison shown to be equally ridiculous and ineffective; one writer remarks that it is "laying a twelve-inch water main and then putting a one-half inch pipe alongside to help it out;" and it has been well said that the weight of copper now used in supplementary ground wires would be much better employed in the form of heavier bonds. A contributor to *The Engineering Record* states that "a section H, 60-lb. Lewis & Fowler box rail has about the same resistance as a copper wire one and one-eighth inches in diameter. No such amounts of copper have yet been used to make bonds, and until they have, the possibilities of rail returns have not been exhausted." The same writer refers to some experiments by Messrs. Warner & Thayer on track resistances, which showed that the resistance of the rail section was so slight that the calculated resistance of the bonds accounted for nearly all of that observed.

In order to decrease the cost of bond wires it has been suggested to make them twelve inches long instead of thirty inches, as is usually done, which would also reduce the bond resistance, and to use rails sixty or one hundred feet long instead of thirty feet. The suggested use of bonds of equal conductivity with the body of the rail and of greater rail lengths is still a step short of welded joints and continuous tracks, which have been adopted on several lines. The principal objection to the use of continuous rails has been the fear that changes in temperature would induce alterations in their lengths, previously allowed for by spacing between abutting joints, and that buckling or deflection of the tracks would thereby ensue. But careful tests on a practical scale seem to have shown that in a well-laid track of this character linear expansion may be disregarded, and that changes in temperature produce their effects "in a minute enlargement and reduction of the sectional area of the rail."* Such a line of double track, three and one-half miles long, is now being laid on the North Broadway extension in St. Louis, the object of its introduction being the desire to decrease the jolting of cars by doing away with rail joints; but the manager of the roads has remarked that an incidental advantage is expected from a more efficient return of the current.

The use of the "three wire system" on electric roads has been advocated by Mr. W. Nelson Smith as a deterrent of electrolytic corrosion, and has been in operation in Portland, Ore., for the past two years, with reported success. In its application for this purpose on a double track road, the trolley wire above one track serves as the positive, the other as a negative, and the rails and earth as the neutral wire. There may be a potential difference from earth of 500 volts to each trolley wire, and 1,000 volts between them. The rails or neutral wire merely carry the current required by the difference in load on the two sides of the line, which is only considerable when cars are starting out or going in, and in the morning and evening business and home travel, or in cases of "bunching." The difficulties in overhead construction and insulation are increased, but it is said that only one-fourth to one-half the overhead copper is required as for a two wire all copper system, such as the double trolley.

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*Jour. Assn. Engnr. Soc., Feb., '93, p. 55.

A common practice is to bury at certain points on the car line old car-wheels, rails, or other forms of plates to collect the ground currents connected by supplementary wires to the power stations. But instances are known where such supplementaries have been used of so great length and consequent resistance, that instead of carrying the current back to the dynamos, they were found by test to be actually positive to the earth. Their insufficiency is more explicitly shown in the experiments* of Mr. J. D. Rastron, Chief Engineer Union Railway Company, Chester, Pa., whose tests showed in one instance that the track and ground supplementary wires were carrying 235.5 amperes of current, the city water mains 12.8 amperes, and the plates, though connected with an unquestionably thorough ground in a creek, but 0.5 ampere. This was doubtless a case with exceptionally unfavorable conditions; but even under propitious circumstances no great proportion of the current could be expected to reach the isolated ground plates, of relatively small earth contact, as compared with the quantity following the long and heavy lines of pipe so widely to be encountered by earth currents.

Recognizing that the currents must follow the main pipes to some extent under existing conditions of railway practice, and that the injurious effects are produced at their points of leaving, the Water Department in Cambridge, Mass., has had heavy copper wires attached to the water mains and carried to the negative generator terminals of the electric roads, that the currents collected by the mains might leave them by a metallic circuit. The water pipes were also connected to the rails, and the water and gas services wired together within the cellars along the route of the road; intentional use thus being made of the pipes as conductors. In Milwaukee the railway company connected their rails to the fire hydrants, but provided no means for the departure of the current until prevailed upon to supply an attachment near the power station. Elsewhere it has been proposed to run feeders to the power houses from the mains in various sections of the city, but not to connect the mains directly to the rails; in other words, to employ the mains, but only as a huge system of collecting ground-plates.

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*Street Railway Journal, Dec., '93, p. 810.

Of the three grades of this arrangement, the last is preferable, but even that is by no means desirable, for it serves to increase the conductive power of the pipes and so invites the approach of currents; and while no especial harm might be done to a perfectly tight water main so wired, a pipe having leaks or loose joints, or a gas main with cemented bells, would be speedily affected injuriously. Nor should the suggested attachment to water mains alone be permitted without protest by gas companies, for if the water mains be made better conductors than before, more tendency will be manifested by such vagrant currents as may have reached the gas pipes to leave them and enter the water mains, so spreading the likelihood and locality of electrolyzation.

Mr. I. H. Farnham, in a recent paper before the Institute of Electrical Engineers, gives the following description of still another plan:

"Prof. Elihu Thomson suggested placing motor-generators along the railway line wherever the cables and pipes are found to be in danger, to be operated by the railway power current; the secondary current developed by these generators to be utilized to lower the potential in the cables and pipes to zero with respect to the surrounding earth or rails. The suggestion included means for automatically starting and stopping the generators, as cables might become positive or negative to the rails. The motor-generators would, so to speak, pump the current out of the cables and force it into the rails whenever the potential of the former should rise above zero. This plan has not yet been put into operation so far as I am aware."

Among the devices described in the foregoing paragraphs are most of those which have been adopted to any extent by the railways as preventives of electrolytic action. As deterrents or diminishers, many of them assist, but not one fulfills the requirement of complete protection, nor can any system do so which uses the rails to any appreciable degree as conductors. On many of the lines of electric railways—perhaps on most of those within the cities—the rails lie parallel for long distances with lines of gas and water mains, much better conductors than equal columns of earth, and in cases of poor bonding often exceeding in conductivity even the rails themselves. Separated from the latter only by a strip of earth, more or less moist, the *capacity* of the rails to conduct all the current is subject to the conductive law of inverse resistances, for so long as the rails offer any resistance at all, some current will also follow the lines of higher resistance. The pipes will be called upon to bear a portion of the current under the most favorable circumstances, and so doing will be injured, for it has been shown by experiment under conditions identical with those existing in practice that electrolytic action may occur with differences of potential of 0.5 volt.

It has been claimed that the perfection of the alternating current motor in its application to street railway work, would solve the problem of electrolysis; and the advantages of this system for long distance power transmission have caused it to be considered for adoption on the Erie Canal trolley line. But though faith in the ability of alternating currents to exert electrolytic effects is not universal, we need not consider the pros and cons, for the motor in satisfactory form is not yet on the market, and the immediate solution of the question before us must be sought apart from its improvement.

A system which many large roads are now adopting as a means of decreasing their current leakage is that of using insulated track feeders designed to carry the entire current, joined to the rails at short intervals, each 400 or 500 feet, for instance. The rails are thus employed as conductors only between the feeder junctions, and the liability of leaking currents is very much reduced. The system is certainly a step in advance of anything we have yet considered; and having been adopted in Boston, Brooklyn, Cleveland, etc., we should soon hear if by its use destruction of the pipes is wholly avoided.

A series of well planned and exhaustive tests of storage batteries, conducted upon a specially equipped road in Washington, showed that no successful accumulator had yet appeared for railway work. Other suggestions have been considered, and as the insulation of the rails themselves may be at once dismissed as impracticable, the absolute and complete prevention of electrolytic corrosion thus narrows to the use of such a system as shall convey the current without the use of the rails or earth for any portion of the distance. Of this character are the double trolley lines, of overhead construction, like those in Cincinnati, etc., or underground, like the conduit systems in Washington and Chicago. Either plan offers full and complete immunity from electrolysis, at a cost for copper no greater than that of a single trolley system with all-copper return. The double overhead design was one of the earliest forms employed, but was generally abandoned for the simpler single trolley on account of the difficulties of construction and insulation. That it is not impracticable is evidenced by its extensive employment in Cincinnati; and were the value of the destroyed pipes added to the costs of single-trolley operation, very little argument might be needed to convince railway managers of the superior advantages of the isolated metallic return.

As to the double underground trolley, or conduit system, invention has been rife in its direction, and many designs are offered, though but few have received practical test. The Love conduit system at Washington and Chicago appears to be operating satisfactorily, and doubtless a number of others of the plans proposed also possess the elements of success. With the saving of ten to twenty-five per cent. in the cost for current—which we are assured would follow the introduction of an all-copper circuit—the probable deterioration of overhead work, relief from the liability for damages to pipes, and the fact that the trolley lines cannot long escape attention in the clamor for putting the wires underground, the prospects for the extension of conduit installation seems favorable.

Another class of injuries from the same general source as the electrolytic has been brought to the attention of your committee, namely, arc effects caused by short interruptions in the continuity of the metallic lines made to serve as conductors. Of this character were the cases in Boston, where the yarn was ignited in the bells of pipes which were being laid, and in Indianapolis, where the leaking current followed down a trolley pole and burned a hole in the natural-gas main close by, the escaping gas from which returned through the hollow pole and was lit at its top, destroying a considerable extent of the neighboring overhead wires. There the railway's system was the greater sufferer; but such poetic justice as this seldom follows. The solution of the electrolytic question, however, will largely carry with it the prevention of this class of effects, so that they need not be specially considered.

In detailing the several plans which have been tried or suggested for the abatement of the troubles which we are considering, your committee have endeavored to show warrant for their belief that the full remedy for the difficulty cannot be applied by those who are suffering from its effects, but *is* attainable by the railway companies, and must of necessity rest with them. That they will endeavor, if assuming the cost of the work, to adopt the cheapest method which offers a measure of protection to the pipes, is of course to be expected. But their responsibility and liability once fixed, we may insist upon their adoption of an absolute preventive, or their rendering of adequate indemnity for all electrolytic injuries to our systems.

The regulations adopted by the special joint committee of the two English houses of parliament, to be applied to electric traction companies installing their systems under the jurisdiction of the board of trade, are much more stringent than any which have been proposed in this country. Our object is to secure the proper protection from injury by systems already in operation, of a quasi-public nature and occupying the streets like ourselves, whose extension we would not seek to hinder or whose methods to question except as they entail danger or expense upon us in our exercise of rights and duties equally important with theirs, and materially antedating them in introduction.

Mr. H. H. Humphreys, in his paper on this subject before the Electric Club of St. Louis, remarks:

"The courts have decided, in numerous telephone cases, that the street railways have a right to the use of the earth as well as other people; but the question whether they would allow the railroad companies to use the gas and water pipes, and by using them use them up, has never been decided that I know of."

The Supreme Court of Tennessee has held,[*] however, in an issue on behalf of a telephone company whose operation was affected by induction at the advent of electric traction, that it was not the legal duty of the telephone company to protect itself, but that it devolved upon the railway company to refrain from causing injury.

In several places where the water supply is conducted by a department of the municipal corporation, the commissioners have notified the railway managers that their companies would be held accountable for damages to pipes, and that the supply of water to their power stations was liable to interruptions unless the source of danger was removed. With the realization of the actuality and extent of the danger, water companies and departments all over the country are taking steps toward obtaining an understanding with the railways causing the trouble; and especially in the cases of such cities as include water supply as a function of the muncipality, the gas companies cannot do better than co-operate with them for mutual protection. If personal and corporate interviews and correspondence with the railway people fail of their object, the courts may be appealed to for restraining orders. Application for a stay of the injunction would doubtless be made on behalf of the railway, and the equity of the question would then be brought to a hearing. But meantime the deterioration of the pipes would be progressing, and even with the installation of a double trolley system decided upon by the railways, some time would elapse before it would be completed. Your committee would then recommend the insulation of all renewed pipes in places found to be injured—the drain tile casing being probably the best for services and small mains, and boxing filled with pitch for larger mains—and the use of cement joints in any new main being laid. The detection of leaks and the determination of unaccounted-for output are so much easier to gas than to water companies that any marked loses on the gas pipe lines at least are likely to be signalized in some manner readily recognized.

In justice to the railway companies it must be said that they are fully alive to the serious character of the problem which confronts them, and are equally anxious with ourselves to remedy and avert the trouble. They have a vital interest in the matter apart from the liability under which they rest for damages to other underground metallic systems, for the solution of the electrolytic question means to them a marked reduction in operating expenses, greater efficiency of the motors, and relief from the menace of interrupted water supply. But they naturally hesitate to accede immediately to demands which would involve the reconstruction of so considerable a portion of their plants; and as one of the electrical journals states, while the double trolley would remove all cause for complaint, the railway companies will exhaust every other means before going to the expense which that remedy would involve. But with recognition of the justice of claims for indemnity for injuries to our distributing lines, and a clear demonstration—such as is now being afforded in several directions—of the futility of any half-way measures, we think that the street railway world will eventually concede the superiority of the double trolley and its kindred systems.

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[*] Street Ry. Gazette, Mch. 24, '94, p. 131; Street Ry. & Elec. News, Apr., '94, p. 44; Western Electrician, Mch. 31, '94, p. 162.

Your committee then summarize their findings as follows:

First.—Electrolysis from the grounded currents of electric roads is rapidly injuring gas and water pipes, and it is admitted by street railway people that the injury does proceed from their operations.

Second.—Complete relief from its action *cannot* be reached by any device applicable by those injured, but *is* attainable by certain changes in the electric railways.

Third.—The gas and water interest should unite in demands for remedial measures which shall secure the adoption of systems undoubtedly effective, and which will thereby avoid a revival of the question a few years hence.

Fourth.—Pending the discussion or completion of the relieving systems, the pipes should be protected at exposed points, at which the policy of increasing the resistance by insulation should be followed rather than that of increasing the conductivity by wiring.

Respectfully submitted,

Geo. Treadway Thompson,
Alten S. Miller,
Jas. Somerville,
Committee.

APPENDIX TO REPORT OF COMMITTEE ON ELECTROLYSIS.

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Irish Closed Conduit, Elec. Eng., †Dec. 21, '92, p. 599.

Love conduit, Elec. Eng., †Sept. 2, '92, p. 273, Oct. 25, '93, p. 370, and *Feb. 28, '94, p. 179; Elec. World, *Oct. 28, '93, p. 342; Eng. News, Nov. 2, '93, p. 346; St. Ry. Jour., Feb., '93, p. 76; St. Ry. and Elec. News, Apr., '94, p. 41; West. Elec., Oct. 28, '93, p. 226. Notes on its success, Elec. Eng., Feb. 7, '94, p. 111; Elec. World, Aug. 19, '93, p. 137; St. Ry. Gaz., Oct. 28, '93, p. 395, Jan. 27, '94, p. 46.

Magnetic Electric Railway Co.'s closed conduit, Elec. Eng., †Feb. 21, '94, p. 160.

Munsie-Coles conduit system, in Hartford, Conn., Elec. Eng., †May 17, '93, p. 480, Feb. 14, '94, pp. 135 and 136.

Oler's Conduit, West. Elec., †Jan. 13, '94.

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Stetson Conduit, of Universal Electric Co., at Coney Island, Elec. Eng., †July 5, '93, p. 12, Oct. 18, 93, p. 342, and *Jan. 17, '94, p. 49; Elec. World, †July 1, '93, p. 13, July 8, '93, p. 31, Sept. 23, '93, p. 238, and *Oct. 7, '93, p. 279; Electricity, Jan. 10, '94, p. 310; St. Ry. Gaz, Jan. 10, '94, p. 35; West. Elec., Feb. 10, '94, p. 64.

Wheless Conduit, at Washington, D. C., may use rail as return conductor, or not; Elec. Eng., †May 10, '93, p. 460.

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American Gas Light Journal, [Am. G. L. Jour.] 32 Pine St., N. Y., weekly. Per annum, $3.00.

Cassier's Magazine, [Cass. Mag.] World Bldg., New York, monthly. Per annum, $3.00; single copies, 25c.

Electrical Engineer, The, [Elec. Eng.] 203 Broadway, New York, weekly. Per annum, $3.00.

Electrical Review, The, [Elec. Rev.] 13 Park Row, New York, weekly. Per annum, $3.00.

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Electricity, [Electricity] 6 Park Place, New York, weekly. Per annum, $2.50.

Engineering News, [Eng. News] Tribune Bldg., New York, weekly. Per annum, $5.00; single copies, 15c.

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Journal of the Association of Engineering Societies, [Jour. Assn. Eng. Soc.] Franklin Institute Bldg., Philadelphia, monthly. Per annum, $3.00; single copies, 30c.

Journal of Gas Lighting, [Journal G. Ltg.] 11 Bolt Court, Fleet St., London, E. C., England, weekly. Per annum, American subscription, $7.00.

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Light, Heat and Power, [L., H. and P.] Drexel Bldg., Philadelphia, monthly. Per annum, $3.00.

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Water and Gas Review, [W. and G. Rev.] 37 Warren St., New York, monthly. Per annum, $1.00; single copies, 10c.

Western Electrician, [West. Elec.] 6 Lakeside Bldg., Chicago, weekly. Per annum, $3.00; single copies, 10c.

DISCUSSION.

MR. THOMPSON—I have here a number of specimens of corroded pipes, gas services and water services, and one specimen of water main. Some of the specimens have their histories attached, and some are plainly apparent from their appearance. Here is the one in which the moist earth was in contact with the pipe for a considerable distance, and the current left it apparently in a sort of sheet. Here is one where the greatest action took place at a union. Here is a specimen where the direction of the rails evidently did not follow the direction of the pipes beyond this elbow. The current left at the elbow and the pipe corroded at that point. The rest of the service is apparently free from corrosion. We have some samples here which have been in service not over one month. One, which was exhibited at Chicago, had been in only one month, and was one of four pieces which had been replaced in the same position within six months. That piece was encased in a drain tile, and when opened last month, after eleven months of service, was apparently free from any action, thus showing that drain tiles are wholly effective, but also showing that the current must have passed out at some other point.

THE PRESIDENT—The report of the Committee which you have heard is very thorough, and is of extreme interest to all members of the Association. I trust the members will discuss the subject fully, and ask such questions as they desire. I feel like saying one thing—I had a letter from Mr. Miller the other day calling attention to the report of this Committee. You can all see that the Committee has done a large amount of work, and Mr. Miller wanted me to say to the Association that he had taken part in it to the extent of signing his name at the end of the report. He wanted the Association to thoroughly understand to whom the credit of this report is due.

MR. THOMPSON—Here is a section of 6-inch water main which has a history. In the *Water and Gas Review* for April, and in the *American Gas Light Journal* of late issue, there was an account of the bursting of a 6-inch water main at St. Louis, which had called forth from the Water Commissioner at St. Louis a letter to the President of the Suburban Street Railway, notifying him that unless steps were taken to abate the difficulty the Railway Company was liable to have its water supply shut off. Here is a section sawn from the main, showing how the pipe was attacked on all sides. This piece is a section from a lamp riser from the corner of Fourth Street and Washington Avenue, St. Louis, where a trolley wire fell across a lamp post and an arc was formed between the wire and the riser, burning through the pipe. The gas escaped to a blind vault at a corner, and was there ignited, and, exploding, carried up some 30 square feet of granitoid pavement. This sample of lead pipe, and this of cast iron, are exhibited by the courtesy of Mr. Andrew J. O'Reilly, the Lighting Inspector of St. Louis.

MR. DUNBAR—Does it affect lead pipe as much as iron?

MR. THOMPSON—Just as much. With us they are affected equally.

MR. DUNBAR—In one place in this report Mr. Thompson gives one of the causes of electrolysis as being due to the electricity leaving the pipe at a cement joint and re-entering a little further on. Further on, he recommends cement joints in the laying of a new main. I would like to have him explain.

MR. THOMPSON—I think the fourth recommendation of the Committee makes that clear—as well as the paragraph following the first remedy, which was considered on behalf of the Water Company: "The adoption of insulation at the current's points of departure would increase the resistance of the mains and so decrease the proportion of current carried." The final recommendation is: "The policy of increasing the resistance by insulation should be followed rather than that of increasing the conductivity by wiring." We cannot prevent some of the current reaching our mains, but by increasing their resistance we can make the proportion of current to be carried as low as possible, and in my opinion it is in that direction that our only means of prevention lies.

MR. HIGHLANDS—Did Mr. Thompson, in pursuing his investigations, try to measure the amount of current going through the main, and its voltage? If, in some of these services that are the most corroded, he knew what amount of current was being carried to the main in that vicinity, and how he determined it?

MR. THOMPSON—A number of determinations were made by Mr. O'Reilly, who used in making them the Weston ammeter and voltmeter. In making connection between water mains he used a cap which screwed upon the water plug, with a binding post for attaching the wire, and then made his connections at the opposite end, by either connecting with the main or else by using a steel rod with a binding post at the top and attaching it by contact with the main above. A number of determinations have been made throughout the city of both the voltage and the amperage carried, and they vary very greatly; but our investigations upon the subject have brought to our notice very forcibly the fact that the voltage does not make much difference, and that a low voltage may in time occasion just as great electrolytic action as a higher voltage. The amperage has varied very greatly, differing according to the distance from the power house, the character of soil, the size of main, and a number of other factors. In one instance a test was made between a water main immediately in front of one of the power houses and a No. 000 copper wire specially run by the superintendent of the power station to the negative bus bar in the station. In that instance 22 amperes of current were being carried. On the request of Mr. O'Reilly, the superintendent at this station threw out his switch, counted 10, and then threw it back again. In that interval the needle on the ammeter was watched, and it fell immediately to zero, but immediately rose again when the switch was replaced, thus showing that the current was not electrostatic, but that it had come solely from that power house.

MR. HIGHLANDS—What was the highest voltage you found there?

MR. THOMPSON—I would not like to say. I have the readings first taken, and some quite high voltages were found. As much as 80 volts have been found in some instances, but those are rare. Still a low voltage is just as effective in destructive action as the higher.

MR. HIGHLANDS—I made a few investigations on that line myself, and may as well admit that the further I have gone in the matter the more I have been nonplussed. A year ago, in repairing a water main, probably a mile from the station, I found a leak in the main due not to electric action (and I will preface that by stating that the street railroad there grounded their rails to the hydrant branches), and in taking the pipe apart, on breaking out the last piece an arc was formed from one pipe to the other, that was probably six inches long. Of course the voltage necessary to make an arc of that kind would be so enormous that it was entirely out of the question for it to have jumped across, so the arc itself was probably formed by following the iron as it dropped out, rather than by jumping across after it fell out. The voltage was high enough to shock the workmen. I then examined to see if there were any currents running from the water pipe to the gas pipe, or vice versa. That was first brought to my attention by the underwriters, who objected to the use of motors in buildings operated from street railroad powers. I connected the gas and water services together in a great many buildings, but have never been able to detect any difference in potential between those service pipes; and on running the wire across the galvanometer would never show any current. The difference between those two actions was so extreme a mile away from the station that there was an arc crossing on a broken water main and upon connecting the service pipes together, and failing to find any electricity by any test at all, was so diametrically opposite that I was staggered in the matter, and have been staggered ever since. I furnish power now to the street railroad companies from the power house of the gas works plant; and we have wired with a return wire from the dynamo to the rails, and to a 10-inch water main that parallels their tracks near the entire length, and also to a deep well, and I have never yet discovered any damage to the pipes in any place from electric action; but at the same time by the large spark which I discovered two years ago I know that the element of destruction is there if the current has not found an easier way of going back. As the result of my experiments and investigations I must say that I know less about it than I did before.

Mr. Thompson—What sort of bonds do you use?

Mr. Highlands—The bonds are No. 0 wire. The bonds are of no use at all.

Mr. Gwynn—How many cars do you operate?

Mr. Highlands—Twelve.

Mr. Gwynn—Is there much travel over the road?

Mr. Highlands—We use from 100 to 350 amperes.

Mr. Gwynn—It is claimed by Mr. Vail, in his paper read before the National Electric Light Association in Washington last February, and also by some other gentlemen there, that the rate of travel has a great deal to do with the matter; that the most trouble would be found where there was heavy traffic and where the cars would be blocked, and that in smaller cities and towns, and where there were few cars, they would have but little trouble. I would like to ask Mr. Highlands whether he agrees with that statement.

Mr. Highlands—I would fully agree with that theory if it had not been for the effects I have found upon the water mains.

Mr. W. L. Brown—I would like to ask Mr. Thompson a question which admits of a practical answer—what would he do in circumstances like ours, where we have an electric road running probably three-quarters of a mile along where we have a main, yet we find our unaccounted-for gas is not increasing. There are no reports of leaks, and the streets are paved the whole distance. How would he go to work to find out where the trouble was? If the destruction is going on there it may be going on all this time at a slow rate, and at some time may suddenly come upon us; but we don't want to wait, and we don't want to tear up an improved street. What would he do in such a case?

Mr. Thompson—Is there any method by which you can isolate a length of main along that paved street, with its cross connections, so as to determine what the leakage per mile of main really is in that distance?

Mr. Brown—Not without cutting the connections, which could be done, of course, but we don't want to go to that expense if it is not necessary. We don't know whether we are getting any injury there or not.

Mr. Thompson—The determination of voltage, and especially of amperage, along a line of main and services wherever they enter houses could be accomplished without any especial excavation; and that would determine quite surely whether there was any action taking place. You could take a service within a cellar and connect to the rails immediately opposite.

Mr. Harbison—In listening to the report of that Committee, and to the gentlemen who have spoken on this subject, not only at this but at other meetings, I have noticed that the principal attention has been given to the injuries that may or may not be done to gas and water pipes. We are just about introducing the trolley system and its blessings in our City of Hartford, and the thought occurred to me whether there is sufficient current on the gas and water pipes to affect human life. What would be the effect upon our workmen who go there to make such repairs as may be needed? If there is electric current sufficient to eat up cast iron mains and heavy wrought iron pipe, in a very few weeks or months, of which the Committee has just shown us samples, what is to become of our men who go into the ditch to repair that work, and have to put their hands to it? Have the Committee given that subject any attention, and is there danger to be apprehended? I would like information on that point.

Mr. Odiorne—We have a main directly under the street rail, and the pipe is very badly eaten, and our men at work on the pipes would be shocked somewhat, but not to any great extent. There seems to be no danger whatever to life. A man would get a shock in his arm, but it would not amount to anything.

The President—Suppose in disconnecting those pipes a person has his hand on each side, what would be the effect then?

Mr. Odiorne—He would get a shock, but it would not amount to anything. And there is a difference in men. Some men get shocks which affect them very badly, while others do not notice it at all.

Mr. Harbison—It might be important to inquire what would be the possible effect of this upon the labor element in the future. We all have to have gangs of men engaged in putting in services, making connections, and in repairing broken mains; and if the pipes are so near to a track through which a strong current is passing, and the shock received injures some men and may kill others, what will be the effect upon the labor element all over the country?

THE PRESIDENT—Can Mr. Chollar give us any information on that subject?

MR. CHOLLAR—We have found, in our experience in operating the Pintsch gas, as the Committee has reported, that the amperage had much more to do with it than the voltage; that with a large current, when it leaves the pipe and is positive to the ground, the pipe is rapidly eaten away. There are some samples here where the pipe has been in the ground or even lying on top of the ground only one week, and yet the pipe is much eaten away. It would seem to me, as it seems to the Committee, that with the overhead trolley and the earth current return, it is utterly impossible to provide against the corrosion of the pipes, and the natural conclusion is that the earth must not be used at all for the return current. We have found it so on the pipes where they are laid on top of the ground, that the current has been so strong that in disconnecting the pipes a spark would arc across and ignite the gas, and that the current had been taken up from the rails and switches, and had accumulated around the pipe to such an extent that the men who were repairing leaks in the Pintsch gas pipe had to wear rubber gloves. Even in touching the pipes with tongs and making a connection across those rails sparks would cross which would light the gas.

THE PRESIDENT—Would you consider that dangerous to life?

MR. CHOLLAR—Not particularly; for I do not think it possible, with the pipe laying in connection with the ground, there could be any electrical voltage in that immediate vicinity which would be strong enough to be dangerous, but still it is very disagreeable, and likewise expensive. As I told Mr. Thompson with regard to our report, it is possible to concentrate it in two words—"double trolley."

MR. BUTTERWORTH—I think you all agree with me that the report of the Committee on Electrolysis is not only very complete and valuable, but that it emphasizes the importance of the question to gas companies by calling attention to the dangers they are exposed to and their helplessness in the matter. I think the consideration of the report of the Committee should not terminate without our placing ourselves on record in a very positive and emphatic way concerning this matter of electrolysis. I would, therefore, like to offer the following resolutions:

WHEREAS, Investigation has shown that the use of an earth return in electric street railway systems necessarily causes a gradual but sure destruction of street mains and service pipes; and,

WHEREAS, The owners of these buried metallic systems are unable of themselves to prevent this destructive action; therefore, be it

Resolved, That it is the sense of this Association that the electric street railway companies can and should promptly adopt such measures as shall insure to all other interests immunity from the injurious electrolytic effects of their operation, and that, failing to do so, they should be held liable for all damages and loss resulting from said operation; and be it further

Resolved, That the gas companies represented in the membership of this Association should unite with the water and other interests affected with them in securing from the electric street railways prompt attention and action in the directions indicated in the report of the Committee on Electrolysis; and

Resolved, That the Secretary have printed 500 copies of the report of said Committee and the discussions thereon, together with these resolutions, for distribution among the members of this Association.

I move the adoption of the resolutions.

THE PRESIDENT—It is moved and seconded that the resolutions as offered be adopted. Are you ready for the question?

MR. HARBISON—I would suggest as an amendment that the Secretaay send to each member a certain number of copies for their use.

THE PRESIDENT—I would imagine that would be the result of the adoption of the resolution; that the 500 copies would be divided among the membership.

MR. SOMERVILLE—I would suggest also that the members give a copy of that report and resolution to the street car companies in their respective cities.

THE PRESIDENT—That is a suggestion for the Secretary and the members to act upon. (The resolutions were adopted.)

MR. COPLEY—In reference to the case at Aurora, Ills., the information which I furnished to Mr. Miller at that time was not as satisfactory nor as certain as that I am now able to give. Since the time I furnished Mr. Miller with this information the city has caused a sewer to be built in the business center of the town, where we have a main on each side of the street for some six or seven blocks. We had no trouble with unaccounted-for gas—that is, our percentage had not increased; and what pipes we had dug up did not show the effect of electrolytic action. I therefore concluded, as I told him, that we had not been damaged; but the digging of the sewer through the center of the street underneath the car tracks in almost every instance opened up to us all the service pipes we had crossing the street, and I can now tell you that I was mistaken in the information I gave at that time. In other words, our service pipes were very badly damaged in some instances, and in others they were not so badly damaged.

MR. THOMPSON—That is what I rather anticipated in the reference to it in this report.

MR. COPLEY—I gave that information to Mr. Miller last fall, or early in the winter.

MR. E. C. BROWN—In the report of his Committee Mr. Thompson refers to the Chester (Pa.) Company. It is either that Company or the Company at Carlisle which has brought this question to the attention of the courts. I understand that argument was to have been had on the 2d of May, but the judge postponed it, as he desired to read up on this question of electrolysis, and I believe that on the 25th of this month he will render his decision as to whether or not he will grant a permanent injunction.

MR. RUSSELL—I would ask Mr. Thompson if the Committee took into account the nature of the soil in which these results were obtained.

MR. THOMPSON—You will find in the report of the Committee a reference to the nature of the soil, and the statement that certain circumstances increase the liability to electrolysis. The samples here presented when prepared for boxing still held good yellow clay upon them, showing that the soil itself was not responsible at any rate for the samples in question. The character of the soil does undoubtedly affect the corrosion to increase it; but moisture is the principal factor.

MR. RUSSELL—I would like to ask Mr. Thompson whether any of the reports that he received were from seacoast towns, or from low-lying places where the soil was continually moist.

MR. THOMPSON—You will find in this appendix a reference to the various reports of electrolytic injuries. Those from Boston, and from some other of the seaport towns, do give special emphasis to the fact that some of the corrosion might have been induced, or at least aided, by the presence of salt water; but so many of them are from inland that salty moisture cannot be depended upon as accounting for the great deterioration shown in the pipes.

MR. ODIORNE—I would like to ask Mr. Thompson whether the samples which he has on exhibition come from pipes which were laid in lead, or in cement joints.

MR. THOMPSON—The main pipe was a water pipe laid in lead joints.

MR. DARRAH—Was that service pipe of steel or iron?

MR. THOMPSON—It is an iron pipe.

MR. BUTTERWORTH—I move that the Committee on Electrolysis be discharged, with the hearty thanks of the Association for their services.

MR. G. H. HARPER—Before you put that motion I would like to ask whether the Committee have an opinion definite enough to be of benefit to the Association as to the danger from fire—where men go to repair a leaky pipe, which has been corroded by the action of the electric current. Whether there is danger of ignition when the men are at work upon it?

MR. THOMPSON—The ordinary leakage from electric corrosion takes place within the earth. In the case of any lines of services where the earth might have shrunk away a trifle, by reason of being laid in made ground, and so permit the escape of gas into the cellars or into an area, there would be that danger. The electrical committee of the Underwriters' International Electrical Association laid special stress upon the danger from electrolysis, but not with reference to fires from gas pipes so much as the weakening and possible failure in water pipes in sections where additional pressure might be put upon them during a fire. You will find their report referred to in the appendix.

Mr. John Young—Is there any danger, in a main charged with gas, in drilling to put in a service pipe, with the gas turned on? I mean, in a main charged with electricity, is there any danger of a spark setting fire to the gas?

Mr. Thompson—There is that danger.

Mr. John Young—We found that out.

Mr. Harbison—That increases the difficulty with the workmen that I referred to.

Mr. Copley.—I would like, in the nature of an amendment to the motion made by Mr. Butterworth, to express more than the usual appreciation entertained by this Association towards this Committee on Electrolysis, for the possibly very great value which this report may have to everyone of us interested in the gas or water business. I offer that as an amendment.

Mr. Butterworth—I accept that amendment.

Mr. Somerville—I agree to the motion if it is distinctly understood that Mr. Thompson is the Committee. (Applause.) A few letters and suggestions comprise all that I had to do with the report; so that Mr. Thompson deserves all the credit for his good report.

Mr. Thompson—I do not think that exception should stand.

The President—Are you ready for the question? Those in favor will say "Aye;" contrary, "No." It is so ordered. Mr. Thompson, you have the thanks of the Association.

Mr. Thompson—On behalf of the Committee I thank you for your appreciation of its work.

The President—We will now listen to the paper by Mr. S. M. Highlands of Clinton, Iowa, entitled

THREE YEARS IN A COUNTRY GAS WORKS.

I do not think it is possible for me to add anything new to the gas industry; but I have long entertained the idea that the business was hedged around with too much mystery, and that the very conservatism that has been allowed to grow around it was one of the greatest drawbacks with which it had to contend. In the smaller cities the gas Superintendent is alone, and in many places very lonely; that he is very apt to think his business a mysterious one; that he is the only man in the community who can master its intricate details; that all he has to do is just to wait until people come to their senses about the electric light craze, and everything will be serene.

It occurred to me some years ago that this was all a mistake; that educating the general public against their convictions is a slow and unprofitable proceeding; and that gas is only a commodity that people can either use or dispense with without very much inconvenience. And, further, that the same methods that are most successful in other lines of business could be used to push the sales of gas, and with equal success. I fully believe that the unparalleled growth of the electric business was because of the efforts to make it popular without regard to any immediate profits.

Infused with these ideas, I assumed the management of the Clinton (Ia.) gas works on April 1, 1891. The works were the usual 6-inch coal gas works, and were built in 1871. In 1875 they sold 5,500,000 feet of gas. In 1884 it had increased to 6,122.000 feet. In 1886 the Thomson-Houston Company built an electric light plant, and the sales of gas dropped to 5,892,000 feet, and in 1890 it had risen again to 6,491.000 feet, with the price of gas ranging from $2 to $2.50 per 1,000.

On April 1, 1891, the price was reduced to $1.75 for illuminating and $1 25 for fuel; and a contract was made for a set of water gas apparatus. At the outset of the new management, the old adage, "The money was made or lost in the retort house," was totally disregarded. The only aim was to make the kind of gas the public would use the most of without much thought as to whether the gas was 16 or 24 candles. or whether it took 4 or 5½ gallons of oil, or 35 or 50 pounds of coal to the 1,000 feet. We believed then as we believe now that the principal duties of a gas manager were to sell gas, and that the making of it was a minor incident connected with the business; that the margin between the cost in the holder and the usual selling price was so great (greater by far than in any other large, legitimate business) that a manager could easily afford to have the cost increased by 10 to 15 per cent., if by so doing he could devote more of his time to selling it, and thereby increase his sales. I will venture the assertion that there is not one manager here who believes he is selling one-half the gas the community would take and pay for, if he could only make it to their interest to do so.

In carrying out this idea, we advertised that for a year we would run free service pipes; sell gas stoves at cost; pipe buildings free, and in a great many places we furnished gas fixtures free. At this time the Company had only 235 meters set, and not a gas stove in use. By May 1st orders began pouring in on us until we had from 15 to 25 gasfitters at work, and during the summer sold 185 stoves and set 392 meters for illuminating purposes. This work cost the Company about $4,000, and you can judge for yourselves whether it is worth this sum to add 577 new customers to a plant that only had 235 to begin with. By September 1st we felt strong enough to tackle the electric light company, and thought a fight with them would advertise us if nothing

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else. We sent a canvasser to all their customers and offered to furnish them with gas for a year for half of the price they were paying for electric light, generally allowing the customer to say how many gas jets he would need to properly light his place. They had 53 customers, and we took 45 of them on this proposition, and had them tied up for one year. This action on our part forced them to sell out to us at once at our price, and we failed to have any fun out of the scheme at all. We metered the 45 contract customers just as carefully as we did the regular ones, and took the statements monthly. It might be as well to state here that these contracts raised a new question in our minds that we will take up some time and settle to our own satisfaction at least.

Please remember that all this occurred in a small town, where the manager could be personally acquainted with each of his customers and know what they were doing, and this article is supposed to be of no benefit to the larger cities. Those 45 contract customers were put on without any idea of making very much money out of them, but rather to force a fight on the electric company. We knew when we took them that some of them would get pretty cheap gas, and we were not disappointed. During the year for which they run, they used 2,894,000 feet, for which they paid $2,171.06, or 75 cents per 1,000. In December they used 600,000 feet, and in July 122,200; one of the largest customers, fairly heating his building with it, and paying only 40 cents per 1,000, while some of them were paying as high as $1.50 per 1,000.

We bought the electric light plant in December, 1891, and immediately reduced the price of electric lights 25 per cent., making the rate for arc light of 2,000 candle power $6 per month, for 9 o'clock lights, and $8 for 10 o'clock lights, the gas contract customers having the option of surrendering their gas contracts and taking the electric light at the new price; but none of them availed themselves of the privilege. At the end of the year none of the contracts were renewed. About one-half of them are now using gas and the rest have returned to the electric light.

We found a great many customers who thought they could afford to use a gas stove, but were afraid to try gas for illuminating purposes; and for such customers we always put a gas burner over or near the stove and connected it with the stove meter. The result was that in a short time the man of the house would come to the office and say that he was tired of sitting in the kitchen to read, and wanted one light in his sitting room; and this was soon followed by several more in other parts of the house at the regular illuminating rate.

Our office is kept open from 7 A.M. to 9 P.M., and all complaints are taken care of within an hour after their being made. A meter prover is kept in the back of the office; and when a customer thinks his meter is wrong we ask him to wait and see it brought in and tested.

We are always willing to settle with him on the basis shown by the prover. I have yet to find the customer who was not perfectly satisfied after seeing this test made, and agreed with us that if there was anything wrong with his bill, the fault was at his house and not in our office.

Another imperative rule is, that while we now have a monopoly of the lighting business, our customers should not find out that we know it; they should all be treated as courteously as they are in any other mercantile house; a trivial complaint should be treated with as much consideration as the most serions one. Another rule that will have more weight with them than all others is, whatever we do must be well done. Nothing temporary allowed and never a makeshift.

In rebuilding the gas works, money was not spared to make it a good one. In rebuilding the electric light plant the very best Corliss engines and high grade boilers were used. The results are that "no gas" complaints are rarely, if ever, heard, and we have not had a claim for rebate on account of "electric light out" for over two years. Our electric service has been so good that the city has just closed a contract with us for all their street lights for a period of 12 years, and the electric street railroad has contracted with us for its power for 7 years.

There have been no changes in prices on the gas for 3 years; and for the past 2 years we have been charging a fair price for all service work; also for all electric wiring and renewals. In the meantime, the growth of the gas business has been much more rapid than that of the electric business.

As I stated before, the Company sold 6,491,000 feet of gas to 235 customers in the year 1890. In 1891, they sold 11,432,000 feet to 627 illuminating and 185 fuel customers. At this time—January 1, 1892—we had 50 commercial arc lights and 800 incandescent ones. For the year ending January 1, 1893, we sold 18,000,000 feet of gas (an increase of 64 per cent.) to 940 customers, and in the year ending January 1, 1894, our sales of gas had increased to over 20,000,000 feet to 977 customers; while the electric lights had only increased to 65 arcs and 1,200 incandescents, exclusive of the street lighting. With the street lighting and street railroad work, the gross business of the electric light plant is larger than the gas business, but is, of course, a great deal more expensive to us to furnish. On the whole, we are satisfied that proper business methods will push the sale of gas just as readily as that of any other commodity, and that without it the gas business is apt to cut a very small figure in small cities.

As some of you probably know, we also supply gas to Lyons, a city of some 7,000 inhabitants, immediately adjoining Clinton. Lyons has a municipal electric light plant that also supplies domestic lights. This plant has been established some 10 years, while the gas mains were only run 3 years ago. At the time we extended the gas mains there, nearly all the stores and shops were using the electric light. We did not make any effort to displace the electric light, but instead concluded we would see what a fair competition between gas at $1.75 per thousand and arc lights at $5.50 each per month would result in. For the first year or so we did not do a great deal of business with the stores. A customer would use the gas through the summer and then put back the electric lights in the winter when the evenings were long. In the summer of 1893, we sent 50 Welsbach burners up there to see what they would do. We equipped one large jewelry store with them at our expense and then waited for results. And they have been surprising, indeed; for to-day there is not one store in the city using electric lights, the Welsbach burners having entirely displaced them; but at the same time it has cut down our sales of gas, and I do not know but that we had better let a few of the electric lights come back, if we can only get rid of the Welsbach burners. The burners are all that is claimed for them, and give our customers unqualified satisfaction; but the confounded things won't let any gas through them. The same jewelry store that was formerly using two arc lights, only used 3,000 feet of gas in December. After our experiment with them at Lyons we would prefer furnishing electric lights, rather than Welsbach burners, in Clinton.

DISCUSSION.

The President—You have listened to the reading of a very interesting paper, and one which has brought out some new ideas, in competition with electric lighting especially. Mr. Highlands is ready to answer any questions any of you may wish to ask.

Mr. J. W. Dunbar—I want to ask, what did those customers who are paying full price for gas think when you furnished some people gas at 40 cents per 1,000? How did they take it?

Mr. Highlands—In answer, I will say they must all have been very busy, for none of them said a word to me about it. I never heard of any complaint. I conducted our business just as they conducted theirs—without regard to what individuals were doing in the matter.

Mr. Copley—I would like to ask Mr. Highlands, with due deference to his cleverness in handling it, what he would have done had his consumers been equally clever, and insisted on arranging with the electric light company for prices, and with him for gas at half that figure?

Mr. Highlands—I have discovered that it is much easier to ask questions than to answer them. I will simply state when I went into the business of contracting with electric light company's customers we did not expect at that time to buy their plant, nor was it done with the intention of forcing them out of the business; but I have frequently noticed, as probably most of you have, that a fight between two dry goods stores on opposite sides of the street will increase the business of both of them, and I did not know but it might do it with us. I wanted to fight with them anyhow, and to see what would be the result when we got through. In making those contracts I had a good canvasser, to whom I gave a list of the parties I wanted him to contract with, leaving it to his discretion as to the price he would make for those contracts—directing him to remember all the time that in what he did he was acting as the employee of the Gas Company. When we got all the contracts we cared for we simply stopped contracting. I believe several other parties asked us for similar contracts afterwards, but we refused to give them, saying that we had all we wanted of them. If it ever created any hard feeling in the community I have not discovered it—any more than it did when we advertised for six months that we would do gas piping free, at the end of which time we stopped it. A great many people since then asked us to do their piping free because we did it then. We shall probably take that question up again. I should not be surprised, when business opens up again, if we should attempt to see if we cannot get customers as I did before—but reserving the right to discontinue the practice at any time I saw fit.

MR. BUTTERWORTH—I would like to warn Mr. Highlands and others who entertain the same views about putting in free service pipes and piping houses free, that before they do so they should thoroughly canvass the situation and ascertain whether or not natural gas is likely to come in in the course of a year or so, or an opposition gas company build up a competition; for in that case the property owners would proceed at once, and without any consideration for the kindness that the gas company had previously extended to them, to turn the natural gas or the gas of the opposition company into their service pipes and houses. We have had that done in our own experience.

MR. CANTINE—I am not a member of this Association, but have the honor of being a member of the Ohio Association, and have taken the liberty of coming here with the idea that Mr. Highlands was going to read a very interesting paper—as he has done—and I suppose that he could make a very much more interesting paper. Mr. Highlands and I fought, bled and died in the gas business long before Clinton was thought of. Let me tell you a little story. He came with us in 1873. The times were then, if anything, a little bit worse than they are in 1894. Your humble servant did the stoking in the daytime and Mr. Highlands did it in the night. He was a little younger then than I, and as he could get along with a little less sleep than I could, he used to take his kit of tools out on the street and do pipe work. He and I together ran the business. Then we got $3 per 1,000 for what gas we did sell. Sometimes one retort made pretty nearly enough. Nearly everybody failed in the town and I suppose that was our only salvation. Had the merchants and business men remained sound we would have failed. Mr. Highlands probably remembers a great deal better about those times than I do, and I came here expecting to be greatly amused by his recital of the good times we had then.

Mr. Douglas—If Mr. Highlands thinks he can save 15 pounds of coal and 1½ gallons of oil by giving the works his personal attention, I think it would pay him to hire another man and then give the works his attention, because he could save a good salary every year in 20 million feet.

Mr. Highlands—In reference to that let me say that I do not now, and never did, take the credit to myself of being a close or economical manager. I said I did not give much thought as to whether it took 4 or 5½ gallons of oil or 35 or 50 pounds of coal to 1,000 feet, yet I think that most of the gentlemen present will concede there is probably somebody up there at the station who did look after those matters, and that there was not any more coal put into the cupola than was burned, and that there was not oil enough put into the gas to make it smoke very much, and we have never sold any tar.

Mr. Holmes—I am not a member of the Association, but thought perhaps the members might desire to hear a parallel case to that stated by Mr. Highlands—but with a different result. Some three or four years ago, I started on the other side, in Youngstown—I mean on the other side from what Mr. Highlands did. The Gas Company took a notion to have some fun with me and they went to contracting for gas at any price they could get; and I don't think they stopped at half way. We had something like 300 customers, and, of course, we had to save them or else get out of the business. But we took another tack. We went for the Gas Company. I think that within three or four days the electric light company had visited nearly every gas consumer in town and asked him for a proposition to furnish light. They immediately went to the Gas Company to get its figures first. The Gas Company was pretty busy for several months taking care of its own customers, while we proceeded with our contracts for electric lighting. But those difficulties have all been settled down there now; we are all harmonious; and I am in the gas business to-day. (Laughter.)

Mr. Highlands—All I have to say with reference to that is this—that our late competitor was the Thomson-Houston Company, a concern to which I know you gentlemen need no introduction whatever.

Mr. W. L. Brown—This paper emphasizes one point which relates to the gas business as it does to every other business—that local conditions dominate what shall be done. Mr. Highlands knew what was being done in his town; he studied the situation carefully and worked to success. Those same plans might not do in another town, so it behooves everyone in looking upon his own ground to carefully study the entire situation, and then follow out the best line he can work on.

MR. SOMERVILLE—Will Mr. Highlands state the population of that town?

MR. HIGHLANDS—We have now in Clinton a population of about 18,000, and in Lyons perhaps 7,000 or 8,000.

MR. SOMERVILLE—The number of consumers was very small when you went there for a population of that size. Nevertheless I wish to congratulate Mr. Highlands upon his paper. It is an excellent one, and shows that he has done excellent work. If these results can be obtained in Clinton, why can they not be obtained anywhere else? I presume the people in Clinton wear the same hats, eat the same food and are just as fond of the dollar as they are anywhere else. If that is so, why cannot this same kind of work be done in other cities and with equally good results? I believe it can be done if the work is carried on in the same line which he has adopted, and which is nothing but work, work, action. That is all about it. You all know very well that for years I have advocated that gas companies should do the gas fitting and have the control of it in their own hands. Here is the result of that course. The purpose is not to make money out of the gas fitting, but to get consumers. I am glad to have heard Mr. Highlands' paper, and I look upon his example as one worthy to be followed.

THE PRESIDENT—In behalf of the Association I thank you, Mr. Highlands, for your paper, and assure you that we appreciated it very much indeed.

THE PRESIDENT—The next paper to be read is that by Mr. I. C. Copley, of Aurora, Ills., on

HOW TO MAKE SMALL ELECTRIC LIGHT PLANTS PAY.

Mr. President and Gentlemen: I am convinced that it is impossible to independently operate an electric lighting plant, at a fair profit, in the smaller cities embraced in the territory of this Association (having a population of less than 25,000) under the conditions that obtain in a very great majority of them. However gratifying this conviction may be to those of us who have been compelled to compete with the much lauded "light of the sun," through all the stages of its extravagant claims and praises, we are much more deeply interested in the question, "How to make a small electric light plant pay." And, as gas men, we are most anxious to know if such a plant can be made profitable in conjunction with the gas industry.

I do not wish to be understood as suggesting a method for each, or any, of my associates to follow, but merely to call attention to conditions that are favorable for the joint operation of these two branches of the lighting business, with an adequate return for the money invested in the electric lighting department. And, if these conditions can be brought about, to recommend the joining of the two interests. Local conditions vary so widely, and the local habits and prejudices of the consumer cut so decided a figure in the conduct of our business, that one who is by necessity entirely unfamiliar with all these circumstances, cannot lay down a few abstract facts and show you all how to make money by simply joining a gas and electric lighting plant.

The altogether abnormal development which has characterized electric lighting in the past, due to the persistent supply man (and I am sure no one who has had experience will question that his mendacious persistence is without parallel in the history of trade), due also to the ignorance of the investor (which cannot be disputed, for the light was but a few years old, and which is not disputed even by those whose pride would naturally prompt them to do so), and due still further to the well known eagerness with which an American public, and particularly in the Western States, seizes upon anything novel, seems to have reached its limit. The supply man may be none the less persistent or mendacious; but the investor is much better informed and less gullible, while the consumer has tried the new light and satisfied himself that in general it is neither as satisfactory nor as cheap as the one it seeks to replace.

The business, then, is rapidly coming around to commercial lines, though retarded in many instances by the prejudice of disappointed rivalry. This is of great advantage to the gas industry, even more so in case of one management for both plants, although it may lessen the desirable features, as we shall later observe.

The most hopeful of the many papers on this subject, heretofore read before similar conventions, have never claimed a direct profit resulting from such ownership that was in any way commensurate with the outlay of capital necessary and the hazzard of the enterprise. But there is one phase of the question I have never heard discussed, and, to me, it is the most important. It is the profit accruing to the gas company as a result of combined ownership—an indirect profit, if you please, on the money invested in electric lighting equipment. Let us suppose an ably managed gas company to have been first to cover its field with the new light. By judiciously timing such a start and investing only as fast as the state of the business would warrant (not at the suggestion of the interested supply man), an expensive competition would have been averted. I shall not attempt to give figures on the direct saving that would have resulted. It is a matter of many small items constantly expended, and may be large or small in amount according to the policy of the management of the companies. I have written several gas companies, operating in competition with the electric light, asking an estimate on the direct annual cost of operating, as a result of such competition. The answers vary as greatly as the pro rata output in different cities, and very much in the same proportion, when local conditions do not complicate the situation. In other words, wherever the policy of the gas company has been liberal and progressive, and money and energy have been expended with good judgment, there you will usually find a better pro rata output than in another city, similarly situated, where the gas company has made no such determined effort. Is it not fair to assume that the two circumstances are connected? If each one of you who is managing a gas plant independently will carefully go over his accounts for running expenses I am sure he will agree that many items could be cut off were it not for the constant menace that the other fellow would get the trade. How largely this enters into the policy of management and allows the delinquent list to creep up can only be determined by each individual manager. In addition to these possible means of saving, let me briefly run over the regular stock of arguments always used on this much discussed subject. There is economy of labor at plant, economy of steam, etc., salaries of bookkeeper and collectors, rent and all the incidental expenses necessary in keeping the office up to the standard. These are the direct and material savings, but the greatest advantage comes from the indirect profit arising from the combined ownership.

That manager of gas and electric lighting interests in a small city who has both gas and incandescent electric lights to sell at rates reasonable in proportion to cost of production and desirability at the same time, and who cannot convince the patrons of his company that gas more nearly meets his requirements, is certainly not in touch with the needs of his consumers, and, as such, is doing his company an injustice. Arc lighting has a sphere of its own. It is not entirely distinct from that of gas, but so much so that the competition is usually devoid of intense feeling. The incandescent light has many of the conveniences of the gas burner and enough that it does not possess to afford a plausible ground for competitive canvassing. These have been placed before the public in all their attractiveness and with all the recklessness of capital unlimited and deceived. And wherever gas has been denied an able and energetic advertisement, the former has made serious inroads in the profit account of the gas company. Wherever the two are owned and managed together the inclination of the public (which we have all experienced and most of us suffered) to give the new light a trial has been very much lessened; for the inclination is not alone to give the new light a trial, but also to give a competing company sustenance. Human nature is thus a potent factor in our business relations. The consumer who gets his information from a source as unprejudiced as the manager of two such companies ought to be, and who sees no opportunity to retard the growth and hamper the success of a passible bugbear of monopoly, is, in my opinion and experience, very likely to conclude for himself that gas more nearly meets his needs than does the electric light. The result is perfectly natural and very desirable; the company holds more of its old customers with gas and sells gas to more new ones.

Moreover, where the two lights meet in competition, the electric light allies itself with all the other enemies of the gas industry to hamper and cripple its usefulness and profit in the great and undeveloped field of fuel. The gas stove has no more active enemy to encounter upon its introduction than the wide awake agent of the competing electric lighting company. Particularly is the entrance hard to effect in new houses where the electric light man desires to shut out all possible competition, and gas once introduced, even for fuel, offers a menace, a possibility of supplanting ultimately. So it is deemed good policy to keep gas out entirely. Those of us in the Eastern and older Middle States do not appreciate this to such an extent as our associates who manage gas plants in the more rapidly growing cities of the Western States, where many of the new, and a large proportion of the best, houses are not piped for gas at all.

All this is preliminary to the answer to the question, "How to make small electric light plants pay." A few moments ago we considered the direct savings. We have now looked hastily at some of the combinations that may and do arise in the ceaseless and seemingly necessarily bitter competition with which the gas men are confronted. If, by a combination of ownerships these may be avoided and the company be enabled to sell a greater amount of gas, it is very easy to realize a greater percentage on the total capital than on the lesser amount invested in the gas business exclusively, in competition with the electric light.

You may say, gentlemen, that I am only suggesting a possibility; certain conditions under which such a plant might be made to pay. It is the only candid analysis I can give, for it is the only way I believe it can be made to earn money in the smaller cities—simply as an ally and associate of the gas selling business. So develop the demand for electric light that the expense of development will be reduced to a minimum, and that gas will receive its greatest benefits, during the process, in the amount sold.

Many able papers have been presented to the various Associations of "gas men" during the past few years on this and kindred subjects. The cost of producing electrical energy has been thoroughly gone over and made known; economy in management has been carefully canvassed, until you have access to all statistics that bear upon the conditions existing in your own cities.

My own contribution is entirely along the line of business policy. There still remains the bugbear of the future possibility in the development of electricity. Other things being equal, granted that we are earning, either directly or indirectly, a profit on our investment, do you not think it worth while to discount those possibilities? Do you not believe that the prior occupation of the field adds a permanence to the value of both plants? Each one of us must review his own situation and answer for himself. Whether these advantages are worth the cost or not depends upon the price paid for electrical machinery, either as first cost where the plant was new, or as the different conditions have appreciated or (more likely) depreciated the value of that used in the experiment of driving the gas company out of business; or whether on one of the flexible principles of reciprocity the gas company can install a plant on its own account and materially influence the depreciation of its competitors.

The public must be treated fairly; but the stockholders of the companies ought to share in that justice. Extensions of the electric department must be made on the same business lines as those which govern similar cases in the policy of the gas company. Prices must be consistent, and the annoying whims of consumers handled with the same judgment. If these conditions can be brought about I can guarantee any manager a reasonable profit through the combined ownership, together with a certain degree of contentment as nearly approaching comfort as the "light man" ever hopes to get.

If the municipal ownership craze takes possession of your city government, my advice, founded on experience, would be: Let the city light its own streets with its own electric lighting plant, and you will hear little more of its going into a commercial enterprise as a source of profit. You will also have much less trouble from competing electric light companies, as will be apparent upon a moment's reflection.

Among the many examples I could cite to support my conviction on this subject, the following will perhaps serve the purpose. There are two cities of nearly equal size within the territory of this Asociation, so near together that local conditions are almost identical. Prices of gas and electric lighting are practically the same. In one the ownership is combined and the company sells 110 commercial arc lamps and has a total of less than 1,800 incandescent sockets, all on meters. It has over 2,200 gas meters and sells in round numbers 60 million feet of gas per year. In the other, the invariable hostile feeling prevails that always attends the rivalry beween a gas company that refuses to be driven into bankruptcy and an electric lighting company that persists in hovering on the verge. Here there are 130 commercial arcs in use and over 12,000 incandescent sockets, partly on contract and partly on meter. The gas company has less than 1,000 meters and sells not more than 25 millions feet annually. I need not give you the relative amounts invested or the percentage of profit realized. Those may be a little abnormal, but they serve as striking examples of the extreme possibilities in the two different lines of policy.

My answer to the question, "How to make a small electric light plant pay?" would be: So handle your business that you sell enough more gas through the combined ownership, and the profit will accrue in the actual money realized, and the permanence that will attach to the value of your plants.

meeting here at this hotel, and the plan was still further revised. We think it is now in such shape that when presented to the various Associations it will meet their approbation, if any plan of federation will. We met here and prepared a plan which will be made into, or rather which will be revised or rearranged into, a constitution and by-laws. There was not sufficient time to complete this work, and present it to this meeting; and a sub-committee has been appointed to take up this work at its earliest convenience, so that this constitution and by-laws will soon be ready for presentation to and action on the part of the various Associations. I might say that the other branch of work which is recommended in addition to that of the adoption of standards, and securing uniformity of discussion in our various Associations, is the publication of our proceedings. The idea which now prevails, and which would be brought about by this federation, would consist in publishing these proceedings in book form, almost similar in character to that which has just been distributed by the American Association—in the form of a quarterly magazine. The proceedings of each of the conventions being furnished to an editor, and the work thus brought out in a quarterly magazine. Of course there are a good many little details that will have to be arranged for, but the first thing to be done will be to ascertain whether the various Associations want to go ahead with the scheme of federation. If they do, it is merely a work of detail to arrange the matter so as to be perfectly satisfactory to the various parties. I think, Mr. President, that is all that can be reported at this time, and the work will have to go over of course until a later meeting.

THE PRESIDENT—We understand that this is simply a report with regard to the action of a committee given for the information of the Association.

MR. LANSDEN—May I ask if the committee which was appointed is to report to this Association, or to the American Association?

THE PRESIDENT—This committee was appointed by the President of the Western Gas Association, upon the request of the American Association, to confer with a committee of that Association, and therefore it should report to this Association.

MR. RAMSDELL—I should have stated that the meeting here at this time was a meeting of the various committees—a committee from the Ohio, the New England, the American, and the Western Associations. Each one of these Associations was represented here by its committee, so that the work as it now stands is the work of the joint conference committee, of which a meeting had been called. Of course each one of these committees will report back to its own Association.

MR. SOMERVILLE—Is it understood that the report of the proceedings of the meetings of the various Associations will only appear in this magazine?

THE PRESIDENT—That has not yet been decided. Mr. Ramsdell has just simply given the ideas presented; and that point has not yet been decided.

MR. RAMSDELL—You will notice I made the statement that there is no desire on the part of the committee to interfere in any manner with the local government of any of the Associations.

On motion of Mr. Somerville, the report of the committee was received, and the committee was continued.

The President announced the appointment of Messrs. Irvin Butterworth, B. A. Ward and W. H. Odiorne as a committee on final resolutions, and then called upon Mr. E. G. Cowdery to read the paper by Mr. J. W. Stratton, of Valparaiso, Ind.—the author was detained at home because of illness in his family—on

SOME OF THE ADVANTAGES OF OIL GAS PLANTS FOR SMALL TOWNS.

Having been a member of this Association for several years past, and in attendance at most of its meetings since 1885, I have been somewhat surprised at the scarcity of literature bearing directly upon the subject of straight oil gas works.

There are at present quite a number of these in operation in the territory naturally contiguous to the Western Gas Association, and I have frequently met the managers of some of the works at our meetings, but have observed that, as a rule, they took very little part in the discussions, and I believe have offered no papers giving their individual experience, or asking for special information. This has caused me to think that perhaps they are so well satisfied with their position in the business that they do not care to exchange ideas with the rest of the fraternity, or else that they are lacking in enthusiasm.

It is not my purpose in this paper to state any new facts, or advance any startling theories; neither do I expect to offer anything of special value, and only consented in my own mind to attempt this production with the understanding that it was to fill in, should there be a paucity of papers, and to be omitted entirely in case of an abundance.

I have in mind many small towns, which are not now occupied by gas works, the condition of which, through lack of prospective growth, etc., would not warrant the outlay of a sum of money sufficient to install and equip the ordinary type of works in most general use, yet which might be made to furnish a comfortable support to an honest, industrious man, if reasonably installed and economically managed.

The ordinary average annual business that can be expected from sales of gas in towns of 4,000 to 6,000 people is $1.50 per capita of population. Business to this extent most assuredly does not justify any extravagant investment, unless the prospect for immediate and substantial growth is assured.

For the small town an oil works sufficient to do all the gas business can be placed in operation for about 50 per cent. of the cost of the ordinary style of coal or water gas works, and consequently might, from almost the start, be able to pay fair earnings on the investment, which could not be expected from the greater capitalization.

In a high grade gas to 60 or 80 candles standard, holder, mains, meters, services, buildings, grounds, and almost everything that goes into the construction account, can be very much smaller, and consequently cost less money than would be required for the more bulky gas, the proportion being about 3½ to 1.

The labor account for operating this works can be kept at a very low figure—any man of ordinary intelligence can learn in a few days to take care of them, nor is any previous knowledge of gas making essential. The oil flows to the retorts by gravity and is almost automatic in its action. The principal care is to regulate the amount and attend to the fire, for in the distillation of oil more careful adjustment of heat is necessary than for coal.

The gas maker will have time in the summer season to assist the manager in pipe laying, house piping, meter setting, fixture hanging, etc., all of which should, in my opinion, be controlled by the owner or manager of the small works. This manager should keep the books, make out the bills, look after supplies, collections, etc., for there will be few ornamental officers or clerks in this combination. There need not be carried any extensive supply of stock for gas making purposes, but there should be provided an iron tank sufficient to hold at least 8,000 gallons of oil, which should be buried under ground.

For use in this retort system I would recommend gas naphtha of 63° to 65°, Baume's scale. Under the improved methods of refining, it is possible to procure this of high grade, uniform quality and reasonable price. The fuel can be coal, coke or wood, whichever, owing to the nature of the location, can be procured on the best terms. Personally I prefer 4-foot cordwood, for the reason that it affords a lively heat at the top of the bench without an excessive amount at the fire box, which, with coal, is destruction to the firebrick lining. I have seen natural gas used with excellent results for heating benches.

For retorts we use ordinary wrought iron or steel pipe, placing six in a bench. The three upper, receiving the oil first, are the superheaters; the lower, getting the full force of the heat, are the fixing retorts proper. The upper last from 12 to 18 months; the lower from 3 to 6 months, dependent upon the iron, the make of gas, and the care which they receive.

The purification consists of washing and passing through dry scrubbers, which are simply perpendicular columns containing perforated diaphragms of sheet iron placed one or two inches apart, the gas passing up one and down the other in its passage to the holder; in our works there are four of these scrubbers.

A good feature of this gas is the fact that cold weather does not deteriorate it in the least, and in the winter, when the most light is required, it is on its best behavior. There being no sulphur in the gas, and just enough of an oily nature to preserve the leather and cases and lubricate the mechanism of the meters, they will last almost indefinitely, which makes it bad for our friends, the meter men, but gladdens the heart of the manager.

Another important factor in its favor is its harmless nature in case of leakage. With an experience of many years in the manufacture of this gas, I have yet to learn of any person who has received injury or positive discomfort from inhaling it.

Being possessed of a strong, pungent odor, leaks are easily detected, and if the "hayseed" should blow out the gas at the hotel, there would be no coroner's inquest in the morning, and you can enjoy the sleep of the just, knowing that you have in no way been instrumental in hurrying any one to the other shore.

The above are a few of the advantages of the oil gas works; many more could be given, but I do not wish to prolong this paper, nor do I suppose that my friends, the managers in the large cities, with their magnificent plants and colossal business, will adopt my recommendations. But to the poor fellow who is struggling along in the contracted field, scarcely making ends meet, it might prove a "Balm in Gilead." Yet, in this age of advancement and sharp competition, prosperity can only be attained by strict integrity, rigid economy, close attention to all details, and courteous treatment of the public. A man who follows any other course will find, sooner or later, that he has mistaken his avocation.

In my opinion, in no other business at the present time is such eternal and undying vigilance the price of success.

DISCUSSION.

THE PRESIDENT—As the author of the paper is not present, I presume the discussion will be limited; however, the subject is open for discussion.

MR. BUTTERWORTH—If Mr. Stratton were here I would ask him if he experienced any difficulty from the stopping up of the pipes which he used for the retorts, by the deposit of lampblack or carbon. It is possible that someone here may be able to speak on that point in Mr. Stratton's absence.

MR. WM. McDONALD—I had experience some years ago in a small gas plant of somewhat similar construction to this; and we had no serious trouble at that time with the stopping up of the retorts. If Mr. Stratton were here I would say one other word. Possibly he is right, but in the gas works I speak of a man was killed by the gas. The mode of manufacturing the gas was very similar to the one he speaks of; so it seems to me there is some danger from oil gas—if you try to sleep in it.

MR. ODIORNE—I would ask if anyone knows what size pipes or retorts those are.

Mr. McDonald—I think Mr. Stratton used either 6 or 8-inch pipes.

Mr. Ferrier—One statement made I wish to except to. He says: "In a high-grade gas of 60 to 80 candles standard, holder, mains, meters, services, buildings, grounds, and almost everything that goes into the construction account, can be very much smaller, and consequently cost less money than would be required for the more bulky gas." I think that in the case of mains and services, with gas of high specific gravity, they would be very much larger. I think that must be stated as an exception.

Mr. Gwynn—The reason Mr. Stratton speaks of using smaller pipes is that it does not require a large volume. A 1-foot to 2-foot burner is generally used; and the volume is so small that a small pipe can be used.

Mr. Lansden—I would like to ask Mr. Chollar a question. Is this not about the same quality of gas as that manufactured under the Pintsch system; and is not that considered deadly when it escapes?

Mr. Chollar—The gas described in Mr. Stratton's paper is identical with the Pintsch gas. The process of manufacture and purification is absolutely the same. The only difference between that and the Pintsch gas is that of distribution; in railroad cars the gas is compressed to about 200 pounds to the square inch in order to economize storage capacity. In regard to the illuminating power of the gas, as stated by Mr. Stratton, we have made many experiments, and find it, as near as we can get at it, to be about 45-candle power. The consumption per burner is about one foot per hour; and consequently, as Mr. Gwynn stated, very small pipes will suffice for the distribution. The gravity of the gas is nearly equal to that of air. It will burn much more successfully with a draft (as in the Pintsch system) than when the gas is consumed in the ordinary open-flame burner, for then it is liable to flicker. In the Pintsch system it is enclosed in a glass globe and it there burns very steadily.

The President—Mr. Lansden's question was, if you did not consider the Pintsch gas as dangerous?

Mr. Chollar—No more so than ordinary coal gas.

The President—But you do consider it dangerous, if inhaled?

Mr. Chollar—Certainly; but not any more so than ordinary coal gas, and much less than water gas.

Mr. Lansden—I understood Mr. Stratton's paper to state that it was not dangerous.

Mr. Russell—I would ask Mr. Chollar what burner he uses?

Mr. Chollar—The only practical way with a bar photometer in burning and testing a high power gas is to use it with a burner small enough so that the gas can be burned without smoking. I have tried it in the photometer. We find in practice that gas made from ordinary oil has about one per cent. by volume of sulphureted hydrogen, and a trace of carbonic acid. In St. Louis we make it in rather large quantities, and it requires little lime to purify it. We purify about 80,000 feet per bushel of lime.

Mr. Ferrier—Can Mr. Chollar give us the quantity of carbonic acid in the gas?

Mr. Chollar—I have never examined the Pintsch gas for carbonic acid, but it would probably be very small—I think less than six per cent.

Mr. Hinman—I have had quite a good deal of experience in testing oil gas made by various processes, and in my experience I have found that it varied from 40 to 60 candle power. I had my burner burn less than one foot per hour and about five feet per hour. I have determined the proportion of carbonic acid very exactly, and found that it was less than two per cent.

Mr. Gwynn—In reference to its being safe, and not dangerous in case of its discharge into a room, I will say that I have known where it was blown out in a room—an ordinary room 10 feet square—in a hotel, escaping all night, and the party who slept in the room came out all right, not even complaining of headache. I think that is due, however, to the small volume of gas discharged into a room. It was a 1-foot burner, so that in 10 or 12 hours the amount discharged was but a small quantity. You would not get as much in 12 hours through that burner as you would through an ordinary coal gas burner in an hour and a half.

Mr. McDonald—Mention was made of a man having been killed in an oil gas works. I attended the inquest, and some very eminent physicians were present who, having held a post-mortem examination on the man, concluded that he was suffocated. That was the result of the examination. While there is not very much poison in the gas, there is enough of it to suffocate a man. It keeps the air from the lungs. He breathes the gas instead of air, and he cannot live on the gas.

Mr. Gwynn—I have had a little experience with an oil gas plant and consider it only a pocket edition of a coal gas works.

On motion of Mr. Thompson, the thanks of the Association to Mr. Stratton for his paper, and to Mr. Cowdery for reading it, were voted.

The Association then adjourned, to Thursday, May 18, 1894, at 9:30 A. M.

SECOND DAY—MORNING SESSION.

The President called the Association to order at 9:30 A.M., and introduced Mr. James Ferrier, of Columbus, Ga., who read his paper on

THE INFLUENCE OF TEMPERATURE ON PURIFICATION.

When I announced, a few weeks ago, my intention of trying to throw some light on this subject, I had a very inadequate idea of the task which I had imposed upon myself. I state this as an apology for the meagerness of my experimental data, which, had I been able to carry out my original intention, would have been much more complete. I cannot expect them to carry conviction, although they may indicate a strong probability. Those of you who have tried to carry on business and experimental work at the same time will readily understand and excuse me.

My first experiments were directed towards discovering whether or not chilled gas would affect ordinary lead dietate test paper. I found that foul gas chilled in U-tubes as low as 4° readily blackened moist test paper, although its effect on dry test paper was almost inappreciable. I may here state that all temperatures given throughout this paper are on the Fahrenheit scale.

After trying several methods of experiment with purifying materials I adopted the following as promising to yield the most reliable information:

1. *Oxide of Iron.*—This was selected from a bed that had been exposed for some months, and from the same part of the bed. The coarser nodules, separated by a sieve, were rejected, and the sifted portion thoroughly minced; 28 ounces were then placed in two improvised purifiers, and throughout the experiments 16 ounces were placed in the first purifier and 12 ounces in the second. The purifiers consisted of the wash bottles so well known in the laboratory, using the short tube as the inlet and the long tube as the outlet. After having been tried at atmospheric temperature the purifiers were emptied and again charged with the same weight of purifying material. They were then immersed in a freezing mixture, and, in order to prevent raising the temperature by warm gas, it was chilled before it reached the purifiers by being passed through three V-tubes, also immersed in a freezing mixture. After leaving the purifiers the gas was led through the indicator. This consisted of another wash bottle, lined half way round with white unsized paper, kept continually moist by a solution of lead acetate, into which the paper was dipped. In order to control the rate of purification a diaphragm was inserted in the tubing on the exit side of the indicator. The diaphragm was made by connecting two pieces of rubber tubing by a glass tube, one end of which was drawn out to a capillary. By breaking off the capillary, or slightly heating it, the opening could be made larger or smaller as desired. The same diaphragm was used during two experiments, one at atmospheric temperature, the other at low temperature. The gas was received in a meter prover, which served also as a meter.

2. *Lime.*—Some pieces of quicklime were slacked and cooled and the slacked lime thoroughly mixed. Two purifiers were then charged with the same weight of slacked lime. One was used and the other was sealed up to await the next experiment. Only one purifier was used in experimenting with lime. This was the modus operandi in

the first two experiments with lime, but it was evident from experiment 6 that "something had gone wrong," as I found on emptying the purifier that the lime was dry and had been acted upon to a very small extent. It is probable that, despite sealing up, the moisture had left the lime and had condensed in the upper part of the bottle. Accordingly, in experiments 7 and 8, I adopted a more rigorous method. I weighed the quicklime, measured the water added, and weighed the slacked lime when cool, making the two of the same weight, both dry and hydrated.

Eudiometric determinations of the amount of sulphureted hydrogen in the crude gas were made from time to time during the experiments, but no such variations were found as would account for the differences in the results. These results and particulars of the experiments are given in the appended table.

In experiments 4, 5 and 8, after the indicator had become fouled, I removed the U-tubes, removed the purifiers from the freezing mixture and immersed them in water at a temperature of 100° to 120°, at the same time placing a clean indicator. In all three cases the purifiers resumed their functions. The oxide showed gas free from sulphureted hydrogen after the first purifier, which in the freezing mixture had begun to show taint after 9 feet had passed. The gas, after heating the purifier, appeared dense and smoky, probably from illuminants condensed while in the freezing mixture. I also observed that the characteristic blackening of the oxide did not extend much below the level of the freezing mixture. In experiment 5 the lime purified 4 feet, after the temperature had been raised, also emitting a smoky gas. The gas, however, was still of a considerably lower temperature than the atmosphere, showing that the chill had not been completely removed. Experiment 6 must be "ruled out" as evidence, for reasons already given. In experiment 8 I found that the freeze and thaw had granulated the lime, probably preventing the action of a considerable quantity of it. The results of this experiment appear greatly at variance with those of No. 5. This may probably be accounted for by the fact that No. 8 was continuous, while No. 5 was interrupted owing to its duration, and may have allowed partial revival of the lime. I regret that want of time prevented me from making some experiments to test the effect of *desiccating* the gas apart from chilling it; this I reserve for future investigation.*

While the experiments appear to prove that the efficiency of both lime and oxide purifiers is impaired by a low temperature, they also seem to demonstrate that oxide is affected more than lime, at all events, in so far as the impurity of sulphureted hydrogen is concerned. This seems intelligible when we reflect that oxide exposed to the atmosphere is revivified—in the language of chemistry, ferrous sulphide is decomposed and ferric oxide again formed by the action of free oxygen. This is accompanied, as we all know, by the evolution of a considerable quantity of heat. Either heat must be absorbed, or compensating influences must be exerted to produce the reverse action. Evidently the absorption of a certain quantity of heat is necessary, although it is still a question whether the heat acts directly or indirectly by increasing through diffusion the influence of the water present.

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*Since writing this paper I have made a few experiments in desiccating the gas by passing it through sulphuric acid and calcium chloride, and the effect has been to demonstrate that the mixture is a potent factor in purification. These latter experiments have only been made with oxide so far.

With regard to lime I wish to direct attention to the papers on this subject read before the Chemical Society of Great Britain, by Mr. Veley, of Oxford University. Briefly stated, Mr. Veley has demonstrated: (1) That quicklime, in the absence of moisture, is totally inert towards such gases as carbon dioxide and sulphureted hydrogen. (2) That with just enough water to form the hydrate, lime is comparatively inert towards certain gases which otherwise it absorbs readily. (3) That the absorptive properties of the hydrate are vastly increased by the addition of 10 per cent. of water. (4) That calcium sulphide, in the absence of moisture, is totally inert towards carbon disulphide. In summing up, his words are: "The presence of a trace of water produces an effect precisely similar to that of heat energy in inducing the combination of substances which, under otherwise similar conditions, are practically inert towards one another."

In view of these facts, I am of the opinion that the deleterious effects of a low temperature on a lime purifier (and, it may be, also on an oxide purifier) arise from the solidification of the water and the consequent withdrawing of its solvent properties. Nor must I omit to notice the condensation of moisture from the gas before it reaches the purifiers. I am also inclined towards the opinion that, under such conditions, sulphur is allowed to pass both as sulphureted hydrogen and an excessive proportion of carbon disulphide. For, in addition to the fact that these and carbon dioxide will not be arrested by a frozen purifier, it has been proved that, under certain conditions, the partially fouled lime will be decomposed, carbon dioxide setting free both carbon disulphide and sulphureted hydrogen, sulphureted hydrogen setting free carbon disulphide, and *vice versa*.

The question now naturally arises: How then to account for the presence of sulphureted hydrogen in the holder and mains and not at the purifiers? To this puzzle I would suggest the following solution: Our coldest hours are between midnight and 6 A.M., and often these hours are our busiest in making gas. I deem it more than a possibility that during such hours the requisite quantity of heat and moisture may be withdrawn from both the gas and the purifiers, and volumes of impurity may be allowed to pass into the holder. The warmer hours of the day will witness the revival of the purifiers, so that a superintendent may make his tests and pronounce "all right," not knowing that in the *chill* watches of the night his sentinels have been benumbed and have been allowing the enemies to pass.

In conclusion, I will reiterate the advice to maintain a moderate temperature in the purifying house, and to that I will add, provide a tell-tale of some kind that will inform you what your purifiers were doing while you were asleep.

TABLE OF EXPERIMENTS.

No.	Purifying Material.	Weight Used.	Temperature.	Duration of Experiment.	Volume Purified.	Cu. Inch per Min.
1	Oxide	28 oz.	57°–73°	7 h. 16 m.	25′ 320″	100.
2	Oxide	28 oz.	6°–20°	23 m.	1′ 377″	91.5
3	Oxide	28 oz.	56°–81°	93 h. 30 m.	92′ 735″	28.47
4	Oxide*	28 oz.	0°–20°	22 h. 58 m.	20′ 237″	25.25
5	Lime†	12 oz. slacked	6°–18°	13 h. 12 m.	14′ 735″	31.47
6	Lime	12 oz. slacked	62°–72°	9 h. 3 m.	10′ 397″	32.46
7	Lime	5 oz. dry 9 oz. slak'd	67°–74°	6 h. 53 m.	9′ 864″	39.75
8	Lime‡	5 oz. dry 9 oz. slak'd	8°–14°	4 h. 57 m.	3′ 1092″	21.13

*Revived on heating.

†Purified 4′ additional after heating.

‡Diaphragm partly stopped. Purified 1′ 1033″ at the rate of 30.7″ per min. after heating.

DISCUSSION.

MR. RUSSELL—I would like to ask Mr. Ferrier what kind of gas that experiment was made with.

MR. FERRIER—With coal gas entirely.

MR. RUSSELL—Had it gone through the condenser and scrubber before you made the experiment?

MR. FERRIER—Yes. It was taken just before entering the purifying house, and after it had passed the condenser and scrubber.

MR. RUSSELL—What temperature did you have there when you collected that gas?

MR. FERRIER—Do you mean before it entered the U-tubes?

MR. RUSSELL—Yes.

MR. FERRIER—The atmospheric temperature in the experiments ran from 57° to 74°. That was the temperature of the gas before it reached the U-tubes, in our climate.

MR. RUSSELL—Did your desiccation take place before the gas entered the holder? You said you used the holder to collect the gas.

MR. FERRIER—The gas entered the holder after it had passed through the U-tubes, the purifier and the indicator. It was simply collected, after passing through the entire apparatus, in the meter prover. The reason I used the meter prover in preference to the test meter is that the latter is not always reliable in passing gas slowly, and, in addition to that, there is a little variation in rate which sometimes interfered with my experiments to a certain extent. So I kept the same pressure all the time by means of the meter prover.

MR. RUSSELL—Was the lime you used rock or shell lime?

MR. FERRIER—It was rock lime.

MR. THOMPSON—One of the queries in our question box has reference to the use of the Dexter process in connection with purification —by introducing a portion of the exhaust steam into the purifiers to supply the moisture necessary to maintain revivification. I infer, from the absence of any reference to it in Mr. Ferrier's remarks, that he has not tried that process. Mr. Sheard, in his monograph on oxide of iron, in the London *Journal of Gas Lighting* of last August, has remarked that the introduction of exhaust steam accomplishes two offices, one of which is the prevention of caking of the oxide, and consequently back pressure, by providing moisture; and the other being the prevention of caking through checking the possible local fusion of sulphur. He goes on to state that since the melting point of sulphur is but 236°, that where we know the temperature sometimes rises high enough to volatilize the moisture present, it is not difficult to suppose that you may raise the temperature locally sufficiently high to also fuse the sulphur. In connection with Mr. Ferrier's "wrinkle" with regard to the use of the test, I may say that we have employed a suggestion, made by Mr. Thomas Turner some years ago before the American Gas Light Association, using a pet cock at the meter, and testing the gas there, in addition to testing it upon the purifier itself; so that there will be no danger of leak at the center seal, or of any portion of the gas passing through material which might have become foul but not yet hardened, which would not be detected at that point. I would ask that the question with reference to the Dexter process be presented in connection with this discussion.

THE PRESIDENT—It might be well to take that up at the present time.

THE SECRETARY—The question referred to by Mr. Thompson is this:

"*What works in this country are employing the Dexter process of admitting exhaust steam with their air for revivification; and what results are being obtained with it?*

THE PRESIDENT—That question will come right along in connection with this paper, and may be discussed at the same time; so that the paper of Mr. Ferrier and this question are both before you.

MR. FERRIER—The question refers more to revivification. I have not seen Mr. Sheard's paper, referred to by Mr. Thompson, but from some experiments I have made I should thoroughly agree with him as to the use of steam near the inlet of the purifier. I would not admit too much steam and incur the danger of forming naphthaline; but that a certain amount of moisture is essential I am convinced. I placed a sulphuric acid desiccator so that the gas would pass through it before reaching the purifier, and soon the purifier ceased to act. I removed the desiccator and allowed the gas to pass directly and without desiccating, and found that my purifier resumed action. I did not obtain quite such distinct results with calcium chloride as I did with sulphuric acid, possibly because the calcium chloride was not as pure as it should be. I should be inclined to put the moisture into the gas a little before it reached the purifier. I would not approve of putting a very high heat by means of steam into the purifier itself, and for this reason. We have in an oxide purifier a solution of sulphur in carbon disulphide, and the effect of high heat would be to evaporate the solution, volatilizing carbon disulphide and leaving sulphur behind. So that high heats have sometimes caused considerable impurity to go into the gas. Therefore I think it would be better to inject the steam a short distance before the inlet of the purifier.

Mr. Thompson—Has Mr. Ferrier made any experiments, or had any experience of his own, to ascertain what temperature would be required to be maintained, or above which it would be dangerous to permit purifiers to go? I mean with reference to the decomposition of bisulphide.

Mr. Ferrier—I have made no experiments myself, but think that an excessive temperature in the purifying house would impair the efficiency of the purifiers. You must remember that one reason why I made a correction in the text is that the solvent property with water, of certain substances which are in the purifiers, rises with a low temperature, although it almost ceases when actual freezing takes place; so I would not advise an excessive temperature in the purifying house.

Mr. Russell—I would like to ask Mr. Thompson if he does not consider that the use of exhaust steam at the inlet of the purifiers is a very bad thing in the use of oxide. We all know that exhaust steam carries a good deal of oily matter with it, and we know that our oxide friends here like to keep the oil out as much as possible.

Mr. Thompson—Replying to Mr. Russell's question, I will say I cannot imagine that sufficient oil would be carried through to effect any injurious action upon the oxide. I do not speak from theory, but from practice. I have employed exhaust steam for more than a year at our works with a great deal of success, and it was the object of the question with regard to the Dexter process to ascertain for Mr. Dexter himself what other works in this country were employing it. Columbus, Ohio, and St. Louis, Missouri, employ it; but I am not

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] That was all I did.

[illegible]

[illegible] with the [illegible] process. We introduce live steam at the inlet of the [illegible] and [illegible] we introduce exhaust steam is because we utilize it in heating water for the boilers, and it is not worth while to use it away from that use. We began this process about the [illegible]. For the year following this date we emptied and refilled only about half as many boxes as we had emptied and refilled the year previous with the same amount of gas and the same [illegible].

[illegible] have been using exhaust steam for 8 or 9 months. [illegible] from the first purifier, and [illegible]. Changing the purifier previous [illegible] by the caking of the oxide. I also [illegible] that way the back pressure [illegible].

[illegible] discussion desired on this [illegible] that the Association is under obligation to Mr. [illegible] for his paper, and for the time and attention he has given to the subject. Is the Committee on President's Address ready to report?

Mr. [illegible], at the request of Mr. Baxter, Chairman of the Committee, read the following report:

REPORT OF COMMITTEE ON PRESIDENT'S ADDRESS.

Your committee to whom was referred the very excellent address of the President have had the matter under consideration and beg leave to report as follows:

We commend the address in its entirety to careful consideration, but especially desire to call your attention to a few points and clauses.

In regard to the question of municipal control of gas works, we believe, with the President, that gas companies who conduct their affairs on sound business principles and keep their property in good condition, can make and sell gas at a lower price than if the same service were rendered under municipal control; but the question is liable to arise at any moment, and every company should be prepared to meet it. The question is a local issue and must be engaged in by each company single-handed and alone. The clamor is based upon human depravity; and the average shouter for municipal control thinks somebody is making too much profit, and at equal prices would prefer patronizing a municipality at a greater, to a private corporation at a smaller profit.

We recommend, as suggested by the President, the appointment of a commission whose duty shall be to gather such information as they may be able to obtain in regard to the cost of manufacture and distribution of gas in various cities; such information to be for the benefit of the members of this Association for use in combating obnoxious enterprises and for spurring themselves to increased activity. We concur with the President in the opinion that the successful introduction of gas stoves and gas appliances requires persistent hard work and continued effort, and commend to the particular attention of our members that part of the address which speaks of this matter.

Your committee further recommend that substantial assistance be given to street railway companies for the purpose of encouraging the use of gas in their motor cars, with a view of securing increased business and at the same time diminishing the chance of injury to our mains and services.

In regard to "federation," it is the opinion of your committee that such a thing is desirable to the extent of providing a means for the doubling up of Association teams, for pulling through and overcoming difficulties too great for each Association alone; but we strongly believe that each Association should jealously keep and maintain its own teams, harness and drivers.

Respectfully submitted,
I. C. Baxter,
Jas. Somerville,
B. E. Chollar,
Committee.

On motion of Mr. Cowdery the report was accepted.

REPORT OF COMMITTEE ON INTRODUCTION OF VISITORS.

THE PRESIDENT—We will now have the report from the Committee on the Introduction of Visitors.

MR. SELLERS—We have with us as visitors Messrs. C. H. Nettleton and W. H. Pearson, of the American Association, and Messrs. W. W. Cantine, F. J. Davis, F. C. Sherman and J. D. Howell, of the Ohio Association. I take pleasure in presenting them to the Association.

THE PRESIDENT—The gentlemen whose names have been given will consider themselves as thoroughly introduced to our members, and made welcome to our meetings.

ELECTION OF NEW MEMBERS.

The Committee on Applications for Membership recommended for election to active and associate membership the gentlemen named below. The Secretary was instructed to cast the ballot of the Association for their election, and they were declared duly elected to membership and welcomed to the Association.

Active.

Cardell, J. H., Supt. Gas Light Co., Memphis, Tenn.
Fitch, Henry D., Gen. Manager Bowling Green (Ky.) Gas Lt. Co.
Fullerton, Geo., Jr., Asst. Supt. Buffalo (N. Y.) Mutual Gas Lt. Co.
Goldsmith, Wm. G., Asst. Secy. Gas Lt. Co., Detroit, Mich.
Harris, Wm. M., Asst. Supt., Mansfield (O.) Gas Lt. Co.
Hathaway, E. C., Supt. Capital Gas and Electric Lt. Co., Frankfort, Ky.
Holmes, B. P., Gen. Manager Youngstown (O.) Gas Co.
Hill, Wm. H., Supt. Erie (Pa.) Gas Co.
Hyde, Eugene A., Sec. and Supt. Ravenna (O.) Gas and Electric Lt. Co.
Knight, J. J., Gen. Manager Kalamazoo (Mich.) Gas Lt. Co.
Logan, John D., Vice-Pres. Newton Gas Co., Whitestone, L. I.
Lynn, John R., Sec. and Supt. Penn Yan (N. Y.) Gas Lt. Co.
Nash, A. F., Sec. and Treas. Windsor (Ont.) Gas Co.
Page, Carter W., Jr., Asst. Supt. Gate City Gas Lt. Co., Atlanta, Ga., 813 Drexel Bdg., Phila., Pa.
Powell, W. E., Supt. Logansport (Ind.) Gas Lt. and Power Co.
Salter, James, Supt. Covington (Ky.) Gas Lt. Co.
Slater, A. B., Jr., Supt. Providence (R. I.) Gas Co.
Westcott, J. F., Consulting Engineer Belleville (Ont.) Gas Co., Toronto, Ont.

Associate.

Callender, Elbert P., *Am. Gas Light Journal*, New York City.
Gardner, James, Jr., Mfr. Firebrick Material and Retorts, Pittsburgh, Pa.

Gassett, A. L., with The Schneider & Trenkamp Co., Cleveland, O.

Hinman, C. W., Meter Mfr., Boston, Mass.

Isbell, Charles W., Mfr. Gas Apparatus, New York City.

Mather, Henry A., Greenpoint Chemical Works, Greenpoint Ave. and Newtown Creek, Brooklyn, N. Y.

Page, Albion L., Mfr. Gas Apparatus, 69 Wall Street, New York City.

Stacey, James E., Agent Stacey Mfg. Co., Cincinnati, O.

Wilke, F. A., Mfr. Wilke China Kiln, Richmond, Ind.

Wilkins, John T., Engineer Connersville (Ind.) Blower Co.

Young, A. W., Youghiogeny Gas Co., Pittsburgh, Pa.

PLACE OF NEXT MEETING.

Mr. Cowdery—Your Committee appointed to select the place for holding the next meeting of the Association adopted the policy of seeking no invitations, believing that the Association has a perfect right to go to any city in the Union it may desire to visit without regard to the wishes of the residents of that city. After canvassing the situation thoroughly, and having in mind every city from New Orleans to Minneapolis, and from Pittsburgh to Denver, it was the unanimous choice of the Committee, on the first ballot, that Pittsburgh be selected as the place of the next annual meeting. Accordingly your Committee recommend that Pittsburgh be selected for the next meeting.

On motion of Mr. Lansden the report was received and adopted, and Pittsburgh was selected as the place for the next meeting.

RESOLUTIONS RESPECTING THE RETIREMENT OF SECRETARY LITTLETON.

The President—Is the Committee on Resolutions, with regard to the retirement of our Secretary, ready to report?

Mr. Howard—Your committee presents the following report:

Whereas, It appears from the report of the Committee on Nomination of Officers that our Secretary, Mr. A. W. Littleton, persists in declining to again accept the office;

Resolved, That the Association hereby expresses its sincere regret at this determination, and desires to place upon record its high appreciation of the able and efficient manner in which he has discharged the important and burdensome duties of the position, his unfailing courtesy, his kindly regard for the interests of the individual members, and his valuable service rendered without regard to his personal convenience or private interest, especially during the trying period of the early history of the Association, and which have placed us all under lasting obligations. We trust that, relieved from the care of this office, he may long continue his interest and activity in behalf of the Western Gas Association.

J. B. Howard,
B. E. Chollar,
C. R. Faben, Jr.,
Committee.

On motion of Mr. Dunbar the report was received and recorded on the minutes.

SECRETARY LITTLETON—Mr. President and Gentlemen: I wish to thank the Committee and the Association for the very kind words in which they have been pleased to refer to my past services as Secretary. Although severing my connection with that office, I wish to assure the Association that I intend to be just as loyal to its interests in the future as I have endeavored to be in the past; and shall always be glad to help it in any way I can.

MR. HOWARD—The Committee desire me to state that if it were attempted to put into print or upon paper their appreciation of the merits of our Secretary we do not think the hotel could supply them with sufficient paper; and so we have confined our report to a few words, intending to give only the pith. It is not necessary to allude in greater detail to the services of our worthy Secretary? He has been in that office for the past twelve years; and his work speaks for him. He has grown up with the Association, and grown not only in strength and physique, but in our love—for who is there that doesn't like Littleton? (Applause).

CHANGE OF MEMBERSHIP.

THE SECRETARY—I have applications from Mr. N. A. McClary and Mr. E. E. Morrell, who were elected some years ago to Associate Membership, but since that time have become eligible to Active Membership, for a change from Associate to Active Membership. Mr. McClary is now the President of the Cicero (Ills.) Gas Company, and Mr. Morrell is its Engineer and Superintendent. According to our By-laws we have no means of making this transfer except by referring the matter to the Association, and it can authorize the Secretary to make the transfer. That has been the custom in the past.

On motion of Mr. McDonald, the gentlemen named were transferred from the Associate to the Active list.

IN MEMORIAM.

Mr. Lansden, of the Committee appointed to prepare notices of deceased members, presented the following resolutions, which were, on motion of Mr. Odiorne, adopted:

Resolved, That in the death of Peter E. DeMill, Jr., this Association has lost one of its most enthusiastic and honored members; one who, it might be said, was born to the gas business, as his father was for many years the Secretary of the old Detroit Gas Light Company; and from his early boyhood young DeMill was pleased to consider himself a champion of the industry we represent—a genial, social, generous spirit, whom we all mourn.

Let us place a garland on his last resting place, and while we mourn with his friends and the surviving members of his family, we can comfort them with the assurance of our esteem and appreciation of his many virtues. After them, he was our brother.

Resolved, That a copy of this resolution be sent to his sisters by the Secretary of this Association.

T. G. Lansden,
F. W. Freese,
W. M. Eaton,
Committee.

ROLL CALL.

Upon the call of the roll the following members were reported as in attendance:

Honorary Members.

Slater, A. B., Providence, R. I.
Harbison, J. P., Hartford, Conn.
White, Wm. H., New York City.
Humphreys, C. J. R., Lawrence, Mass
Leach, H. B., Taunton, Mass.
Barker, F. E., Boston, Mass.

Active.

Averill, G. M., Cedar Rapids, Ia.
Baxter, I. C., Detroit, Mich.
Beal, W. R., New York City.
Blodget, C. W., Brooklyn, N. Y.
Brown, W. L., Evanston, Ills.
Butterworth, Irvin, Columbus, O.
Chollar, B. E., St. Louis, Mo.
Christie, W. H., Corning, N. Y.
Clark, Walton, Phila., Pa.
Copley, I. C., Aurora, Ills.
Corley, J. A., Owensboro, Ky.
Corscot, John, Madison, Wis.
Cowdery, E. G., Milwaukee, Wis.
Cowdrey, R. E., Topeka, Kas.
Croul, J., Detroit, Mich.
Darrah, S. M., Wheeling, W. Va.
Douglas, H. W., Ann Arbor, Mich.
Dunbar, J. W., New Albany, Ind.
Dunlap, H., Emporia, Kas.
Dunlevy, H. H., Wheeling, W. Va.
Eaton, W. M., Jackson, Mich.
Evans, C. H., Chicago, Ills.
Faben, C. R., Jr., Toledo, O.
Ferrier, J., Columbus, Ga.
Freese, F. W., LaPorte, Ind.
Fullagar, W. E., Port Jervis, N. Y.
Greenough, M. S., Cleveland, O.
Gwynn, Joseph, Steubenville, O.
Harper, G. H., Altoona, Pa.
Harris, G. S., Mansfield, O.
Highlands, S. M., Clinton, Ia.
Howard, J. B., Galena, Ills.
Hyde, G. A., Cleveland, O.
Hyde, H. H., East Saginaw, Mich.
Jenkins, E. H., Columbus, Ga.
Jones, C. D., Independence, Ia.
Kellar, C. M., Columbus, Ind.
Knight, C. S., Fort Wayne, Ind.
Lansden, T. G., Washington, D.C.
Light, George, Dayton, O.
Lindsley, E., Cleveland, O.
Littleton, A. W., Quincy, Ills.
Lynn, J. T., Detroit, Mich.
McDonald, W., Albany, N. Y.
Malin, H. A., Joplin, Mo.
Miller, C. R., Pittsburgh, Pa.
Morgans, W. H., Pontiac, Mich.
Murdock, J. W., Ottawa, Ills.
Odiorne, W. H., Springfield, Ills.
Penn, J., Washington C. H., O.
Perkins, B. W., South Bend, Ind.
Printz, E., Zanesville, O.
Ramsdell, G. G., Philadelphia, Pa.
Raynor, C. H., Adrian, Mich.
Russell, C. P., Brooklyn, N. Y.
Sellers, W. B., Covington, Ky.
Shelton, F. H., Philadelphia, Pa.
Small, J. C., Aurora, Ind.
Soden, W. T., Emporia, Kas.
Somerville, J., Indianapolis, Ind.
Steinwedell, W., Quincy, Ills.
Stratton, R. J., Decatur, Ills.

Tayler, G. H., Warren, O.
Thompson, G. T., St. Louis, Mo.
Ward, B. A., Michigan City, Ind.
Warmington, D. R., Cleveland, O.
Wilkiemeyer, H., Evansville, Ind.
Young, J., Allegheny City, Pa.
Young, R., Allegheny City, Pa.

Associate Members.

Adams, C. F., Chicago, Ills.
Bissell, W. G., Chicago, Ills.
Bredel, F., Milwaukee, Wis.
Brown, E. C., New York City.
Buss, J., New York City.
Cressler, A. D., Fort Wayne, Ind.
Dell, J., St. Louis, Mo.
Dickey, P. S., Chicago, Ills.
Felt, H., Jr., Cincinnati, O.
Goodwin, W. W., Phila., Pa.
Gribbel, J., New York City.
Guldlin, O. N., Fort Wayne, Ind.
Harper, H. D., Chicago, Ills.
Hauk, C. D., Chicago, Ills.
Hayward, S. F., New York City.
Helme, W. E., Philadelphia, Pa.
Higgins, C. M., New York City.
Keeler, H. E., Chicago, Ills.
Kendall, J. R., Terre Haute, Ind.
Logan, W. J., New York City.
Loomis, B., Hartford, Conn.
McClary, N. A., Chicago, Ills.
McIlhenny, J., Phila., Pa.
Mayer, J. F., Baltimore, Md.
Morrell, E. E., Chicago, Ills.
Moses, F. D., Chicago, Ills.
Osius, G., Detroit, Mich.
Persons, F. R., New York City.
Prentice, A. T., Chicago, Ills.
Randle, C. H., Chicago. Ills.
Roots, D. T., Connersville, Ind.
Roper, G. D., Rockford, Ills.
Russell, D. R., St. Louis, Mo.
Stout, J., Chicago, Ills.
Stratton, S. S., Chicago, Ills.
Van Wie, E. G., Chicago, Ills.
Waugh, F., Chicago, Ills.
Weber, O. B., New York City.
Wickham, L., St. Louis, Mo.

THE PRESIDENT—Yesterday afternoon the Committee on Nomination of Officers made their report, and we elected officers for the ensuing year. For some reason the officers elected have been in hiding ever since, but we have finally got them here, and we would like to have a word from them as to whether they will take the offices to which they have been elected. I will first call upon Mr. I. C. Baxter of Detroit, the President-elect.

MR. BAXTER—Gentlemen of the Western Association: I thank you for the honor you have conferred upon me by electing me to this position. With the assistance and co-operation of the officers and members, I shall endeavor to do my duty as your President. Again, I thank you.

THE PRESIDENT—We will hear from the First Vice-President, Mr. W. H. Odiorne of Springfield, Ills.

MR. ODIORNE—I thank you very heartily for the honor you have conferred upon me, and I assure you I will endeavor to do my duty as far as my ability goes.

THE PRESIDENT—Mr. S. M. Highlands, the Second Vice-President-elect, does not seem to be present. We will hear from the Secretary-elect, Mr. J. W. Dunbar of New Albany, Indiana.

Mr. Dunbar—Mr. President and Gentlemen: I assure you I am appreciative of the honor, and also of the responsibilities and duties of the office to which you have called me, and which have been so faithfully and earnestly performed by our retiring Secretary. I shall endeavor to perform those duties faithfully, and hope to be able to do so in a manner that will be satisfactory to all of you. I can hardly expect to do so well as our Secretary has done; but with your assistance I hope that our meetings may be made as successful in the future as they have been in the past. I thank you for the honor.

The President—The next thing before the Association will be the reading of the paper by Mr. Wilkiemeyer of Evansville, Ind. I will state that Mr. Wilkiemeyer was called on for this paper at the eleventh hour, and had but a very short time in which to prepare it. The paper itself needs no apology, but we are under obligation to him for undertaking to write it at such a late date.

Mr. Wilkiemeyer then read the following paper on

THE BEST METHOD OF INTRODUCING GAS STOVES.

No truer truth was ever told than that "Every dog has his day." The invention and incomparable utility of to-day, to-morrow becomes an antiquated specimen of a bygone age. Time, which is the great changer of all things, in its mutations has affected every phase of human existence, both political and domestic. The march of civilization has in no way made such giant strides as in our common, every-day domestic economy.

Our warlike forefathers waged bloody and brutal battle with the club and stone. Their grandchildren used the spear and sped the deadly arrow from the springing bow. Their offspring in their turn used the battle-axe and battering-ram. Awkward engines of war were from time to time invented and took the place of their more crude predecessors. Finally gunpowder revolutionized and changed the whole mode of war, and it, too, as a power, sees its decadence in plain sight before the forward march and the encroaching genius of the great electric magicians of our productive century. Before the bells toll the death of 1899, the great explosive, gunpowder, will be relegated as an engine of destruction in a promiscuous heap of cast-off war-clubs and tomahawks.

The first drinking cup was the hollow of old Adam's hand, and the sparkling spring water of Eden was carried to his lips with as refreshing effect as the bon vivant quaffs his vintage of Tokay.

As man's habits became less predatory and his habitation fixed, as he learned to utilize the cattle that first came under the dominion of man, his drinking cup was a cow horn stuck in the ground. After tables came into use he cut off the point of the horn and bottomed it with wood or leather. He finally learned the use of common clay, and ere long discarded the chip plate and the horn cup for the lovely products of Dresden and Limoge.

Our father Adam and our mother Eve were clad in aprons made from the broad leaves of the forests. Their early sons were clad in the untanned skins of wild beasts. The dwellers in some sunny clime, driven by necessity, the great mother of all our progress, discovered the fibrous bark of certain trees, and wool and hemp were for centuries the only coverings of our developing race. Then came King Cotton with gay calico, and now we all feel best in broadcloth and delight to see our wives and daughters clad in finest silks and softest satins, products of the skillful weavers of the world.

When man first went to housekeeping his establishment was all of a piece, primitive and simple. He sought some thick-leaved tree or overhanging rock to shelter the heads of himself and his family from the raging storm. On the prairie, where Nature was not so beneficent, he stuck a pole in the ground and over it stretched the hide of some conquest of the chase, or with his stone axe, in the primeval forest, he hacked down a few poles and erected a mansion of wood. With further development in the ever-revolving progress of time he dwelt in houses of stone and sun-dried brick; and now steel and iron, and marble brought from across the seas, contribute to the erection of the modern palaces which grace our most magnificent municipalities.

Our first cabin, dark at night, was rendered habitable in the day by an open hole in its wall, through which the wild and wintry wind had free passage; then, greased paper let in the light and kept out the wind and rain. But now who but has his plate glass front in windows of house and store?

The man who lived and had his being early in the world had little chance to learn anything of this footstool except of the small and circumscribed locality in which fate had settled him. If he listed to travel by land he must walk or ride some animal; if by sea or water, the slow and toilsome oar, or dangerous sail, was all his motive power. But now, in pace with modern progress, he travels in a single month the journey which in the olden days would have required the span of a long and active life. He circles the world in a flash and skims across the seas with the speed of a swallow.

For countless ages the learning of the world was locked in the possession of a sacred few. Knowledge, which was and always will be power, was a closely guarded and jealously kept secret. The rolls of papyrus containing the secrets of the ancients and the foundations of the philosophies of the world were but for the few and favored. Books were hoarded as the miser hoards his gold, and the great storehouse of universal knowledge was barred and barricaded to the world. But now education is universal. Books are in reach of all, and every day for the pitiful sum of a single penny you may learn of every current item of human interest in the whole world. Great journals printed over night contain the daily record of important happening of the world. Whole libraries that cannot be read and digested in a week are turned out every twenty-four hours, and their information is within the reach of all who desire it, for a nickel. What the kings and queens of the old world are doing, who they have married or intend to marry, what congresses or parliaments contemplate, new inventions, policies of nations, new discoveries of science, new productions in art, sins committed, scandal exposed, wars, fevers, trials, treaties, policies, both private and public, you may read of for a cent.

Great colleges open wide their doors to the youth of the land almost without price, and learning, useful, profound or superficial, is actually within reach of all who wish it.

While our ancestors were, by toiling "from early morn to dewy eve," from the breaking up of winter to full planting time, scratching up a few acres with their wooden mold boards; while the whole winter was occupied in flailing out the garnered grain, we now see the steel share driven at lightning speed across broad acres, and machinery of various kinds doing farm work in a single day that was once the work of months. "The weary plowman" is now a thing of the past, and the "agriculturist" sits on his sulky plow and rides at ease during his whole day's work.

The first men survived on raw meat, herbs and roots, but the modern stomach has been educated to the necessity of more elaborate culinary preparations.

"Man may live without poetry, music or art;
He may live without conscience, or live without heart;
He may live without friends, he may live without books;
But civilized man cannot live without cooks."

Good eating, and perforce good cooking, is not only one of the prime luxuries, but is a necessity of life. When we come to consider, fairly and candidly, the pleasures of our existence, the table and its burden is not the least to be considered.

As man has made such wondrous strides of advancement in all other temporal affairs and conveniences of his daily existence, so has he progressed in the science and art of cookery. Books are written on the subject. It has become a recognized science, and some of its eminent professors draw larger salaries than judges and congressmen. Fire (and from fire heat, and from heat power) is one of the greatest gifts of God to man. It is related in ancient mythology that early in the ages the secret of fire and of its production was the exclusive property of the gods. Prometheus, a benevolent inhabitant of the skies, gave away the secret of its production to mortals, who were heretofore deprived of its incalculable benefits. In punishment for this offence he was condemned to live eternally chained to a rock on a bleak mountain side, where the wild vultures each day devoured his [illegible], which each day were renewed. This legend demonstrates the great appreciation in which the ancients held this most useful element.

The dearest wish of a good wife's heart is that her family and her friends may think well of her cooking. And what husband, worthy of the name, does not delight in furnishing her the improved means and conveniences in this, the life-work of many women?

Labor-saving devices are promptly sought for and grasped by man, and his loving helpmate should not be overlooked when it comes to a consideration of such matters.

The open fireplace and the Dutch oven have given place to the modern wood and coal stove; but with even this improvement, what a world of dirt and dust and discomfort is connected. Even as the whole world progresses, so has cooking and the means of cooking progressed, and it is the object of this paper to demonstrate the best, safest and most economical device ever up to this date invented for the convenience of our beloved cooks. And thus, having logically demonstrated to the nicety of a theorem the constant improvement in all material matters, I am brought face to face with the subject of this paper, "Gas stoves and how to teach the people that it is for their interest to use them."

Despite the experience of the past, that present esteemed and appreciated aids and assistants in "the art of living" are constantly giving place to, and improved methods, means and machinery, there is a lingering dread, a sort of half-believed suspicion, in any new thing. And even though its benefits and advantages may be read by him who runs, and speak out loud enough to reach the ear-drums of all the land from the mountain tops, every new idea must be advertised and electioneered for.

We who are engaged in the manufacture of artificial gas are interested in this matter because it affords an increased field for our operations, an extended market for our commodity. That which is worth our possession is worth striving for, and if we desire to extend our markets, there is an open and accessible field spread plainly before our view. We must constantly show the people the manifold advantages to be gained by an abandonment of that filthy fuel, coal, with its attendant and concomitant evils of dust, ashes, sparks, expense and labor; and that the oft demonstrated danger and fatality connected with the use of that most volatile, destructive, treacherous, death-dealing, property-destroying compound known as "Gasoline."

It is a well-known and patent fact that there is no article or commodity of commerce that "sells itself." While life insurance is a desirable thing and should be taken advantage of by every man with a family, it is not chronicled that any man ever went to an agent and asked to be insured. The farmer must be seen before he sees the economy and the necessity of his purchasing some article of labor-saving machinery. The great trunk lines of railway covering this fair land in all directions, all have their agents out to solicit trade and patronage. In fine there is no enterprise, however much of merit there may be in it, that wins success of itself. It must be pushed. It must be advertised. It must be boomed. It must be talked. It must be *shown*. The common run of humanity have lost much faith in the statements of printer's ink. They by no means are so gullible as to believe all they read. The most eloquent and flamboyant declamation in printed advertisements by no means carry conviction of the truth of the statements. The way to impress a customer is not by vivid word pictures, but by an actual demonstration of the merits of the article offered. The evidence of the eye is much more satisfactory than that of the ear. In law the "eye witness" is the most desirable when it is desired to establish a fact beyond a reasonable doubt.

A personal appeal or interview is always productive of better results than a communication by wire or mail.

I by no means intend to deprecate the value of good and judicious use of the public press. The newspapers of to-day and of the past have been and are active, useful, indispensable agents in the propagation of good ideas, and a proper use of their columns is always productive of the most apparent good results. They are a most necessary means to the end in view. But we cannot depend upon them alone as a medium of advertising a good thing. We must get down to work ourselves. The man who has the interest of his gas plant at heart, and who has an ambition to make an increased market for its product, must have the tact and the patience and the knowledge of human nature, and must be able to read character in faces, like the insurance man, the book agent or the projector of any other commodity.

In the first place he must have a thorough knowledge of the science and philosophy of the article sold. He should be able to answer all questions suggested by the ignorance or the acuteness of the prospective buyer. He must be able to show its merits, and to explain away any fancied and chimerical objections to it. No chance to talk gas stoves and to expatiate upon their economy, their cleanliness and their labor-saving qualities, should ever pass by unused.

A practical demonstration of the benefits to be obtained by the use of gas stoves always awakens many to a knowledge of their benefits,

On one occasion I secured the services of a baking powder firm. and gave them space, stove and fuel. The cooking was done in front of a plate glass window in full view of the passing public. The long table, fitted up with snow white damask, delicate china and shining silver presented a picture of neatness that would have given an appetite to an anchorite. The lady shoppers dropped in and enjoyed an afternoon lunch, gratis. Business men were invited to a substantial noonday meal all cooked upon a gas stove in plain sight.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] plant and to increase [illegible] the man who has been placed [illegible] is the man who has [illegible] his lieutenants. [illegible] sought and trained. [illegible] daily papers constantly before [illegible] the clamoring crowds [illegible] Like all other generals. [illegible] the qualities of [illegible] and a general salesman.

[illegible] produce more than it is [illegible] business is to see there is no [illegible] every dollar invested is bringing [illegible] plant is doing all it can do.

A man active by nature and practice in this particular field of action has a great scope. He knows it to be a fact, and he can prove it, too, that the introduction of gas as a fuel, will bring in a new era of domestic economy, and will not only lighten the burdens, but ameliorate the condition of thousands who are delving in a never-ending fight between danger, death and dirt.

Not only that, but until his plant is selling its product to its full capacity will he be considered up to his business, and fulfilling the object of his being.

DISCUSSION.

THE PRESIDENT—We have heard a very able paper upon a subject in which we are all interested, and it should be well discussed. Mr. Wilkiemeyer says that "We must carry the war to Africa." I don't know whether he means to carry it to Georgia or not. The matter is before us.

MR. HOWARD—I think I will make a start in this discussion by referring to the early introduction of gas stoves. I do not know the exact year gas stoves were first used in the United States, but I can relate a little reminiscence dating back a few years, and so give you an idea of what was done in the city of Brooklyn, N. Y., in the year 1850. I was working there at that time at my trade as gas fitter, and the gas fitters desired to get up a supper, and to have everything cooked, baked and roasted by gas. An Englishman working in the shop, who had not been here over a year, said, "Boys, if you will give me time I will get up a gas stove that will do all the work of cooking for the entire supper required for that evening." Going to work at it, he built a stove that roasted the meats and baked the puddings; and one item was roasted especially well. One of the fitters had a cousin who was a steward on one of the Collins line of steamers, and this cousin gave the fitter an English rabbit, which English rabbit was roasted by this same stove. Everything was very nice. Another thing specially noticeable with regard to that supper, and especially commented on by the owner of the hotel, was the gravy. It was especially clear and nice, particularly the gravy of the roast mutton, which had none of the brown, burnt appearance so common; and although he could not understand why it was so clear, and without any tinge of brownness, he had to acknowledge that the meat was cooked properly. I will state that that same man (I want to give him the credit for it, for oftentimes it happens that a man does not get credit for what he has done until after he is gone) also got up a small open heating stove, much like those you see to-day, only of different material, in the grate of which he placed broken pumice stone, in pieces the size of your fist, also intermixing with it some asbestos. Many people who did not know anything about the qualities of asbestos wondered how the stuff could make such a fire and still did not burn away. He called it "salamander," thinking he would hold the secret to himself; but in a short time everybody found out what asbestos was. This same man got up what was called the patent socket, used for drop lights and portables. If he had taken a patent out for it he would have become a very wealthy man. He was the first one to get up that socket, and the first one was a piece of cork inserted with a small piece of rubber. He also got up another thing, a patent on which would have been valuable, and that was the rubber bucket for chain pumps. I allude to this to show what a genius he was. The chain pump in those days was simply a chain with round iron rings attached to it. He had the idea of a rubber cup, inverting it, and placing that on the chain instead of the iron ring. He did not care about patenting that, thinking it was of no great value, and thereby again lost money; for after awhile it was patented by a man who made a fortune out of it.

Mr. Evans—We adopted a rather novel method of introducing gas stoves, by distributing circulars to every family on the line of our street mains, offering to give them a gas range free. Of course the object of this circular was to bring possible consumers to the office, where we could explain what we meant by it. Of course we had a "string" to the offer. Our explanation was simply this; If the consumer would pay for $20 worth of gas in advance we would give him a $25 gas range, or, rather, a gas range he could not purchase for less than $25 at retail. Of course they could not understand such an offer. Our explanation was that by the use of $20 worth of gas, having acquired the knowledge of how to use gas properly, they would become permanent consumers. Of course the facts were simply these: They paid for the gas in advance; we had the money to buy the stoves with; we made a profit on that $20 worth of gas sold which was nearly enough to pay for the stove (laughter); and we got a permanent consumer. Perhaps I will modify that a little by saying that it does not cost any more to distribute 200,000 feet of gas than it does to distribute 100,000 cubic feet. In figuring on the cost of gas, in that deal especially, we figured on the cost of the gas in the holder; and our profits accrued on the margin beyond that. As a matter of fact it did bring us in immediate business. On that plan we put out 1,500 gas ranges within three months; and those gas ranges brought us in a consumption of 150,000 feet per day; and as a matter of fact we made $9.40 per thousand profit (laughter)—I mean $9.40 profit on each $20 worth of gas sold; and between that and what the gas ranges cost us was certainly an advertisement that paid us to adopt that system.

The President—The idea is a good one, and I think it has been tried by some others, though not perhaps in exactly the same way. Has any other gentleman any information to offer on this subject?

Mr. Copley—Those who have sold gas stoves in a small way have perhaps acquired some experience and have some information as to the best manner of selling them. The best method of selling gas stoves must necessarily be a personal history with each man—inasmuch as he has probably adopted the plan which to him seemed best, and which has furnished him his experience. I live in a town of 23,000 or 24,000 people. Five years ago last February there were not over 12 ranges in use in Aurora. We have now a little over 1,100 in use in the summer, and probably from 400 to 450 in use throughout the year. The policy we adopted from the very start was this—which, with certain modifications which managers must be able to take advantage of as they present themselves, might, I think, be advantageously followed by others. We visited each church society that holds a sociable in its basement, as they do in many cities, or that holds its sociables or suppers at the pastor's house, and gave to each society a range outright. We said to them, "We could not afford to do this with all of you if it were not a matter of business. We have a kindly interest in your association, but still it is a matter of business with us. We want you to take this stove and use it. We want you ladies to see that we are offering you something that you cannot well get along without." We also went to the other organizations of ladies, such as the Woman's Relief Corps, the order of the Eastern Star, and the Woman's Christian Temperance Union, giving to each of them a range, not a cheap one, but gave them outright the best range we could buy. There are four daily newspapers there and we advertised in each of them. We not only advertised, but we saw to it that our bills amounted to a little more each year for advertising than the newspaper paid us for gas. We have no deadheads on our line. We settled with most of them once a month. The newspapers are constantly mentioning us and our business kindly, and they also take the trouble to mention gasoline explosions, and where no fatal results follow they simply remarked that people had better go and see the Gas Company about it. Of course we see to it, when they call upon us, that all the horrors which have been averted are brought to their attention. We endeavor to sell, instead of a cheap range, a good one in every instance. When a customer comes into our office we tell him in so many words that the best range is for him the cheapest. We ask him how many there are for whom it is proposed to cook. If it is a small family we advise him to buy a stove of moderate size; but if he has a large family we tell him in so many words that he cannot buy a range for $15 which will do the work of a $30 stove. During the first two years we sold our stoves at cost, and gave some away. We lost money on them; but I have yet to find any business that can divert trade from one channel to another without spending both time and money. Since the second year we have been selling stoves at a profit. For example, whenever we are allowed a discount of 40 per cent. by the manufacturers we give a discount of 25 per cent. We frankly tell customers just what the stoves cost us. We say to each hardware dealer, "We don't want you to sell gasoline stoves. If you will sell gas stoves you need have no money invested in the stoves, for we will carry them for you. You know this lady and that lady better than we do. If you can induce her to buy a gas stove you can come over to our office and take that stove for just what it costs us at the factory, and we will pay the freight and deliver it. So that besides the profit that you will get on the stove, you will save freight and cartage." We say the same thing to each gasfitter in town. Consequently we have five plumbing firms in Aurora that are urging their friends to buy gas stoves, because on every $30 gas stove that they can sell they can pick up $5 or $6 with a very little trouble. We have the money invested, and we take the trouble to show the customers how to run the stoves. The newspapers are with us in every instance. Anything special we take occasion to arrange for under a contract as special advertising. We take pains with all our customers who have bought stoves to see that their stoves worked satisfactorily, and that they are given proper attention. And above all that, we constantly urge upon our customers the fact that gas stoves are not a toy, but are a necessity, and that the best is the cheapest.

MR. COWDERY—Unlike one of the previous speakers, I do not agree with him altogether in the words that he used, although I may in his ideas. I think a law can be laid down as to the best method of introducing gas stoves in every city in the country, and it is expressed in a single word—"advertise." In seeking to introduce gas stoves as rapidly as possible in Milwaukee, we have studied the art of advertising, and have devoted all our efforts in that direction—expanding our ideas to embrace new things, picking up novelties in advertising, and doing anything and everything in that line to attract attention. I think that expresses the whole thing—"Advertise."

MR. SOMERVILLE—I would like to ask Mr. Copley, who seems to be very successful in introducing gas stoves, if he makes any difference in the price of gas.

MR. COPLEY—We do not. We make a uniform rate of $1.25 per 1,000 feet in Aurora, which is a town of 23,000 people. After canvassing the situation very carefully in our own city we have concluded that it is to the best interest of both the consumer and the company to make but one rate for gas, and to make that uniformly as low as possible.

MR. HARPER—I will mention that in the town with which I am connected we have adopted the plan, both last season and this, of employing a competent cook, who is duly established in the office, and is there employed in baking cakes and pies to illustrate the adaptability of gas stoves for that class of work. Last season we were quite successful in that method, so that we actually made a profit in our stove department; and this year we have started in on exactly the same plan, and have so far been very successful.

MR. HIGHLANDS—In respect to the methods of selling gas stoves, my impression now is that one of the best ways is to find a good gas heating stove. I have looked the market over to the extent of my ability for the last two or three years, but I have not as yet found a gas heating stove that I can recommend to my customers. We have a great many gas stove manufacturers here, and I think it would be well to call them to our assistance. The gas heating stove that our customers insist upon buying is, first, a stove that they can afford to use; next, a stove such that they can live in the same room that the stove is working in. A stove that must be connected with a flue becomes rather expensive; and one that is run without a flue connection in our vicinity insists upon being the sole occupant of the room. I stand here ready to give any man an order for 100 or 200 heating stoves, if he can give me stoves that will heat the room without wasting the heat that is produced by the gas; something that will be attractive, and at the same time economical. I will solve a part of the question how to sell gas stoves if any manufacturer will give me such a stove.

THE PRESIDENT—I hope that the manufacturers will make a note of this, and will see to it that Mr. Highlands gets what he wants.

MR. ROPER—I will refer Mr. Highlands to Donald McDonald, of Louisville, Ky. He can get from him a stove such as he requires, and one which will permit people to live in the room with it. I am not very good at descriptions, but I think that Mr. Wilkiemeyer has been a little bashful in relating his own experience. He has started in on one new scheme which attracts a great deal of attention. I got into Evansville at 11 o'clock at night, and had occasion to pass his store, which was the most brilliantly lighted place in that town. To give you a little description of the room is about all that I can do. In a 3-story building on the principal street in the town, he has the ground floor, the front being filled with two large show windows, in which are exhibits, and a chandelier is in each window. As you enter the door (a large double door) you come in contact with all kinds of gas appliances, arranged on both sides of the store. I think he has two rows of stoves—that is, two rows on either side of the room, running back I should say 70 or 80 feet, possibly a little more than that. Then you come to the clerical part of the office. In the center of the room are two or three combination chandeliers. The first one I think is electric light and Welsbach; the next I believe is electric light and gas, and I think the third is electric light and Welsbach. As you go back to the office, the desk comes part way out into the room. He has a palace back of that. There is no obstruction in the way, so that the clerk at the desk, as he is working at his books, can see anybody who enters the door. If the person stops to look at a stove he has an immediate chance to go out and sell it to him. He has, besides the stove, Douglas heaters and Goodwin heaters in operation. Then in front of his counter is an elevator. He uses the three stories as his store. On the second floor I believe he carries supplies, electrical and otherwise, and on the third floor is the meter department. A man who wants to look at a gas engine can be shown one running the elevator in the building; so if a possible purchaser comes in and asks to see a gas engine he immediately starts his elevator, otherwise it don't run. I believe he has the nicest store and storeroom of any gas company I know of. I do not know of anyone, except the Company at Grand Rapids, that has anything like the room that Mr. Wilkiemeyer has. He can describe his palace to you better than I can.

Mr. Lansden—I do not want to question Mr. Highlands' objection to the existing gas-heating stoves, but I think it is well not to lay too much stress on it. I don't think we will ever find a successful heater that will not vitiate the air. The perfect combustion of gas makes carbonic acid. How few rooms are arranged to take it all out! The successful heater must always be connected to a flue. I have in my experience found very few places where I could not connect to a flue. There is no process by which you can get heat into a room, except by steam or hot water pipes, but that a flue connection must be made. Why should we call upon gas to do something which no one has ever known to be done by anything else? I believe electricity might accomplish it, but in all other processes of heating we know the waste products of combustion should be carried away. I think if Mr. Highlands will talk the matter over quietly with his consumers he will be able to satisfy them that there are stoves in the market which answer all requirements for heating purposes. I do not want to hear the gas stove men recommending gas stoves which do not connect with a flue.

Mr. Cantine—As I understand it, the great objection to a flue is that it carries off so large a percentage of the heat. That is the trouble with gas stoves. It is estimated that only about 10 per cent. of the heat is made use of, the balance going off in the flue. If he will use a different kind of flue, that is, make a small flue of sheet iron, and send it down through the floor and underneath it to the flue, he will find he can put his hand on that and let it remain there without being burned. Such a flue will carry off all the offensive odors and everything that would tend to vitiate the atmosphere. It is the only thing that will do it easily, readily and without trouble.

The President—I saw recently a blue print of a gas furnace which was located in the basement of a house, and heated the house very much like other furnaces of that kind do, and I believe it will be quite a success. It will be on the market in a very short time.

Mr. Lansden—A stove that I have is connected immediately with the flue, but the pipe drops 6 inches and then runs straight into and connects with the flue. I can lay my hand on that pipe and hardly feel its warmth. It takes away all the product of combustion.

Mr. Somerville—Of course it would be an ideal thing if we could get rid of the products of combustion; but we must always remember that when we have a number of gas burners burning in our room the products of that combustion are going into the room all the time. We are all using gas in that way, and yet we all look pretty healthy. As I look into the faces of the men around me I cannot see that they indicate any great amount of suffering by reason of living in rooms in which gas has been burned in that way. If that is the case, why should we fear to introduce a little stove that will burn only about 12 feet per hour and fear the products of combustion? I see no reason to be afraid of that—considering we are using gas in that way all the time. I think with the usual amount of fresh air that is coming into a room there is no occasion to be afraid to introduce a little stove of that kind for heating purposes.

Mr. Odiorne—Does Mr. Wilkiemeyer make a practice of connecting cooking stoves with the flues?

Mr. Wilkiemeyer—No.

Mr. Odiorne—Not where they are used the year round—winter and summer?

Mr. Wilkiemeyer—I do not know that we have any that are used the year round.

Mr. Copley—I would like to ask Mr. Wilkiemeyer if he has ever found that where he has failed to connect a range with a flue, after a few years, and particularly in cold weather, do not the housewives complain that grease settles on the wainscoting or wall in the vicinity of the back of the stove? We had a case like that. At first we recommended that no one connect with the flues; but after running the stoves for two years we began to have complaints from our customers that grease would settle on the kitchen wall near the stove, and we began to look into the matter (I would like to know if we are right in our conclusions), with the result that we found there was a continual pouring out of vapor from the products of the combustion of gas, which vapor was laden with a little grease, and which settling on the wall finally became noticeable.

Mr. Wilkiemeyer—We have had complaints of it.

Mr. Copley—We have recommended connection with the flue since that, but never did before.

Mr. Murdock—I have had such an experience as that. We put in a connection to the flue, had the kitchen repaired, and had no more bother.

On motion of Mr. Odiorne a vote of thanks was passed to Mr. Wilkiemeyer.

The President—The next paper will be that of Mr. William McDonald, of Albany, N. Y., on the

HISTORY OF THE GAS METER.

Gas, as we understand the term, has undoubtedly, to a greater or less extent, existed in all ages of the world. It is, however, just about one hundred years since its manufacture for useful purposes was first attempted. It has, I think, been true of all human progress that the discovery or invention of anything new has always produced a want for some other new thing. This is particularly true as regards the discovery that gas could be manufactured or utilized for commercial purposes.

The history of the difficulties encountered by those who first attempted its manufacture, how they struggled with the generating, the holding, the purifying and the conveying apparatus, are all of interest to the student of the history of gas. It is not my purpose to take up your time with a recital of these difficulties, but proceed to the consideration of the topic I was instructed to write upon by the Executive Committee of this Association, namely, "The History of the Gas Meter."

That the gas meter has a history is because that when the gas maker had found means to distribute his gas he faced the necessity of having some means of knowing how much his consumer used. This was found to be a task surrounded by great difficulties, and it was about twenty-three years after gas was first manufactured before the first gas meter was invented. There is some little confusion in the records as to by whom and just when the first gas meter was produced. It seems, however, that this honor may be conceded to Mr. Clegg, in the year 1815, and it was a dry meter, composed of tin cases inclosing bladders, upon which were laid weights to give the pressure when the gas was excluded from these bladders, the currents of the gas being changed by means of mercury seals. Many difficulties were experienced in trying to make this meter work, and very many articles were used to take the place of the bladders, but we have no account that they were successful, or that the meter was ever made practical.

The next attempt at a meter was the wet meter, which was first invented in 1816, but, like all new things, it was defective and did not work satisfactorily. It had some of the principles which still exist in the wet meter of to-day, but was often improved, and in 1819 was substantially changed and brought to more nearly resemble the present wet meter, and first became of real service. The history of this meter seems to be the history of all inventions; first, a crude idea accomplishing the desired purpose to some extent, but very imperfect. In connection with the improvement of this meter we find the names of a number of people who have since become familiar to the student of early gas lighting, and whose works have come down to the present day, and some who are highly honored as the fathers of gas. In this connection I would mention Mr. Clegg, Mr. Malam and Mr. Crossley; and I would also note here that to the writings of Mr. Clegg, Mr King and Mr. Richards I am largely indebted for the facts of this early history.

It is not my purpose in this paper to dwell upon the various improvements that were made in the early days of meter manufacturing, but rather to give you the main facts, so far as they can be ascertained, and, if possible, give you some thoughts that may be of practical value on the general subject of meters.

Since about the year 1820, when the wet meter had been made in such form as to be of practical value, there have been very many improvements, most of them in the direction of securing a fixed water line, some for the protection of the consumer, others for the protection of the gas maker; but in all the history of meters it is proved that the simpler the machine the better it answered its purpose, so that the original measuring wheel in its simplest form is now universally used by gas companies for measuring the amount of gas made. In the consumers' meter there is added to this a simple float and valve, so that if the water from any cause becomes lower than its proper level the flow of gas is cut off. There is this to be said of the wet meter, that so long as the measuring drum and connecting gearing are in order and the water is at its proper level, it is under usual normal conditions an accurate machine.

The first dry meter, after the attempt before mentioned, was patented in England, in 1820, by Mr. John Malam, and consisted of a tin case containing six pairs of diaphragms and a valve, which corresponds to some extent with what is now known as the rotary valve, but instead of being of the present form was a series of tubes revolving within each other. This meter was never brought into practical use, and the gentleman who invented it met with the difficulties that had been encountered by all people who have tried to use rotary valves in connection with the working of a dry gas meter, that is so much friction that it retarded the flow of the gas.

No other attempt seems to have been made to produce a dry meter until the year 1833, when a man named Bogardus invented one; and if some of our friends, who of later years have undertaken the invention of gas meters, would go back into the history of the efforts of Mr. Bogardus they would discover very many of the devices that have latterly been put upon the market as meters, and their efforts, like his, will soon prove to be of no practical value.

The next attempt at a dry meter, or at least the next that seems worthy of mention, was the meter invented and patented by Mr. Defries, which was the first dry gas meter that ever came into practical use, and was what is now known as the three diaphragm, rotary valve meter, and has been very largely in use from the time it was invented to the present day, with the exception that the slide valve is generally used instead of the rotary.

What is known as the two diaphragm meter, and which is more largely used at present, in fact has almost universally succeeded all other consumers' meters, is the one invented by Mr. Croll and Mr. Richards and patented by them in 1844. This, like all other meters of the early days, had a rotary valve, which after a time was succeeded by the slide valve, and which is now, I believe, almost entirely used by all the best meter manufacturers.

Although I cannot, and I am sure you will not, agree with the following description as given by Mr. Clegg of this diaphragm, yet it is my firm belief that if properly made and of the right kind of material it is the best that has ever been used. Mr. Clegg says: "In this meter the measurer of the gas consists of a metal disc or piston, which alone in its passage to and fro displaces the gas and can only displace a quantity equal to the area of the disc multiplied by the distance traveled through; such distance being controlled by metal arms in connection with the valves, which, when once properly adjusted, cannot vary, so that the area distance being fixed, a like quantity of gas is discharged by each backward and forward motion of the disc. The leather is so arranged as to allow the disc free play in its motion, but takes no part in the displacement of the gas."

The principle in which this gentleman expresses so much confidence is undoubtedly correct, but many of us to our sorrow have found that his confidence was to some extent misplaced, as we well know, and as some of the papers lately presented to the gas conventions apparently prove.

This, I think, gives you a very fair synopsis of the history of the meter before its introduction into this country. I have had some difficulty in getting the dates necessary for this history, and may not in all cases have them exact, but they will be found to be approximately correct. I am indebted more or less to most of the other meter manufacturers for the information here presented, but principally to Mr. W. W. Goodwin, of the Goodwin Meter Company, and Mr. W. N. Milsted, President of the American Meter Company.

Meters were first manufactured in this country by the New York and Manhattan Gas Companies, of New York City, and their manufacture was commenced in about the year 1834, and of course were all wet meters. Colton & Code commenced the manufacture of meters in Philadelphia in the year 1834. Samuel Down, in the city of New York, in 1841; Mr. Down having been previously employed by the New York Gas Company in the same branch of work, he being succeeded by the firm of Down & Merrifield. Colton & Code were succeeded by Colton, Code & Co., they by Code, Hopper & Gratz, and they by Code & Hopper. In 1863 this concern was merged with the firm of Down & Merrifield, constituting what is now known as the American Meter Company. Harris Brothers commenced the manufacture of meters in Philadelphia in the year 1849, and out of that still existing concern have sprung at least eight others, four of which still survive, namely, J. J. Griffin & Co., Helme & McIlhenny, the Goodwin Meter Company, and the Keystone Meter Company.

In the year 1855 the manufacture of meters was commenced in the city of Albany, N. Y., by D. & H. McDonald. They tried for a time to manufacture cast iron case wet meters as then used in Scotland, but soon found this meter was not adapted to American use. In the year 1858 was organized the firm of D. McDonald & Co., which still continues. At the time of the organization of this firm, the writer worked for them for $2 per week, and the present firm is composed of the writer and Mr. N. E. Sisson, who was at that time also one of the organizers; this making the firm of D. McDonald & Co. the oldest in the country, having continued for 36 years without change of name.

The manufacture of meters was commenced in the city of Baltimore, Md., as near as I can ascertain, some time between the years of 1863 and 1866, by Dickey, Baker & Co., this firm being succeeded by the one of Dickey, Tansley & Co., and in 1867 by the present existing concern, the Maryland Meter and Manufacturing Company. I do not know just when the manufacture of meters commenced in Boston, but I think about the year 1859, by the Tufts Brothers, which concern continued for many years, but finally, on the death of Nathaniel Tufts, divided into two concerns, known, I believe, as Nathaniel Tufts and the Tufts Brothers. These, I think, constitute all the older concerns who at present remain.

During the period from 1848 until the present time, there have been quite a number of meter houses started which have proved unsuccessful. I will not take up your time with a rehearsal of their history, as in many ways they are similar, the failure coming principally from two causes, lack of knowledge of the business; and, no doubt, some of the earlier ones from strong foreign competition.

Prior to 1864 meters were admitted to this country free of duty, and the meter manufacturers here had very great difficulty in sustaining themselves against the English competitor; but after 1864, when 40 per cent. *ad valorem* duty was placed upon them, the meter people began to prosper. At this time 3 light meters were sold at about $10 each, the price being gradually reduced, until now the prevailing price is $5.25 net for a 3 light meter, other sizes, of course, in proportion. I desire to call your attention to the fact that these prices are from 7 to 10 per cent. lower than meters are being sold in England, and also from some careful investigation I have made of late, I am satisfied that meters made in this country will average a better quality than those made in foreign lands.

There have been, during the period of which I have been speaking, many experiments tried in the way of improvements and changes in the mechanical construction of these goods, but it has been pretty thoroughly settled that what is now known as the Glover 2 diaphragm meter, with slide valves and the present simple construction of gearing, has proved the most successful.

This paper would not be complete without some mention of what is now known as the prepayment gas meter. This consists of an attachment placed upon the ordinary meter by which a certain coin can be placed in a slot and, from there passing into a receiver, the consumer can receive the amount of gas for which the coin pays. These meters have all been invented, so far as the writer knows, in England, and have been of quite a variety. Some of the meter manufacturers in this country have obtained rights to manufacture under English patents, and as the meter with this attachment seems to meet with considerable favor, there is a strong probability that they will be quite largely used in the years to come.

The writer has made considerable effort to examine the construction of these various attachments, and believes that some are fairly good and that some are entirely too complicated for the use designed. It is my opinion that in the near future some enterprising Yankee will invent a prepayment meter that will far exceed in usefulness and durability any that have yet been produced.

It is too early to speak of any practical results from the use of these meters, as none have been in use in this country until the present year, and these even are very few in number; but that there is a field for the prepayment gas meter no person familiar with the workings of the gas business can doubt. It is estimated that there are between forty and fifty thousand of these meters in use in England, and while this might seem to indicate a fairly general use, yet it is true that in many of the cities they have not even tried them, their use in any quantity being confined to a few of the larger cities, Liverpool probably being the most conspicuous example, where it is said there are between ten and twelve thousand. The advantage claimed by the gas companies there is that each of these meters is an additional customer, as they do not try to put them in use with their old consumers. So far as I know, in all cases they charge a slightly increased price for the gas, and I believe the coin used is in all cases a penny.

There are some things that will operate against the rapid introduction of these meters in this country; one is the large price it is necessary for the manufacturer to obtain for his goods, as according to the best information I can secure, the prices will have to be at least double those now charged for ordinary meters, namely, $10.50 for a 3 light meter. Owing to the complicated machinery, there is very considerable liability to get out of order, and while in some of these meters the arrangement for adjusting to changes of price is comparatively simple, yet the frequent changing of the price would cause trouble, as each meter would have to be carefully adjusted to suit.

There has been, in this country, some difficulty experienced on account of the varying sizes of the coins, as you will all notice if you study the subject; the nickel and the 25-cent piece vary quite considerably in size, depending upon the different issues. There is, however, one great benefit to be derived from the use of these meters, which I think will be appreciated, and that is with consumers of doubtful ability or willingness to pay, it does away with deposits.

I am fully aware that to many of you this has been a dry subject; I have, however, done the best I could with the time and opportunities at my disposal. As before stated, it is my wish to add a few thoughts of a practical nature.

In the issue of April 23d of the *American Gas Light Journal* was published a letter, which the *Journal* stated bore the signature of Mr. Wm. A. Aldrich. I have the pleasure of an acquaintance with Mr. Aldrich and am somewhat surprised that he should have gone into print with a letter of that character. A casual reading of the letter by a person unfamiliar with the meter business would give the impression that the man had said something, and whatever impressions might be gained would be of the wrong kind. He states that in his experience, that out of every 100 old meters tested under proper conditions 66 per cent. were found fast. I have known of several instances where 100 meters in use from one to three years have been tested without even one meter being found fast; this is unusual, but still does occur, and there are so many conditions entering into the test of meters as they are tested when removed from use, that no person can say what the average might be.

Again, Mr. Aldrich asks the question whether air or gas was used in the test, and then states that .033, the difference in specific gravity between air and gas, should be added. Does he mean that this is the difference between the gravity of coal gas and air, or the gravity of oil gas and air? I simply call your attention to the piece for the purpose of showing that the man did not really appreciate what he was writing about.

In testing old meters, the use of gas instead of air, if it made any difference, would show in favor of the gas company, for the reason that if there was any leak on the inside of the meter the gas, being of less gravity than the air, would therefore pass more rapidly through the leak, thus making the meter show slow. I contend, however, that under ordinary circumstances, the meter being tight on the inside, that a test at the same speed (not with the same outlet of course) would give very closely to the same result with either air or gas. I naturally speak from the meter manufacturers' standpoint, and after 36 years of continuous work in the meter business I find there are still many things to learn.

I cannot close this paper without expressing the opinion that between the meter manufacturer of experience and proved honesty and the manager of the gas company there ought to be the most friendly relations. There have been many improvements made in the details of meter manufacturing in the past 20 years, and very careful thought has been given to the subject, and it seems to me it would be wise for parties who are using meters, in case any question comes up regarding them, that they consult some one of experience, and that whatever matter comes into print on this subject should be the result of careful thought and long experience.

I thank you for your kind attention, and trust the slight effort I have made may prove of some practical benefit.

DISCUSSION.

THE PRESIDENT—You have listened to a very interesting paper, and one from which we have gained a great deal of information. It will pass into our records as a valuable contribution to the history of gas meters. Does anyone wish to be heard on the subject?

MR. HARRISON—I was very greatly interested while listening to the reading of Mr. McDonald's paper, but could not help feeling some degree of disappointment when he came to the closing paragraph, because we all know Mr. McDonald's taste in the fine arts. The gas manufacturer and the meter manufacturer should be in perfect harmony and have confidence in each other; but in my opinion it is of quite as much importance that the gas consumer and the gas meter should perfectly understand each other and have entire confidence in each other—particularly the consumer in the meter. If one of us wants to buy a carriage he pays a good deal of attention to the way in which it is finished. The same is true with respect to a piece of furniture or a suit of clothes. Those who wear tall hats like to see an elegant shine on the hat. Why should not the gas meter look as well as any piece of furniture in a man's house? It is very easy to have it so; and Mr. McDonald knows it well. He, as well as other meter manufacturers, has been practicing for years in the finish of the meter, in improving the outside appearance. Years ago you would not see in a gas meter factory any meter that was not like the "imp" of the coal hole—black. If it has no sins to mourn for why should it be in perpetual mourning? It can be made and is being made and finished by various manufacturers in such a way that it is an attraction. We have not bought a meter for certainly 15 years, and I think 20 years, that has not been finished as a piece of household furniture, painted a light chocolate color, and nicely stencilled on the outside and face. When our men go through the street on the wagon with meters in it, or with a meter under their arms, the people look on and admire it. They believe that with a such a meter there can be no trouble about its measurement; that it will do its duty correctly—and it does. It will not ruin any gas company to have the meters decorated in this way. It will not cost you over two cents a year on the life of the meter to have this finish put on. Mr. Goodwin, the American Meter Company, Mr. McDonald, or any other first-class manufacturer, will be very glad to fill your orders at a cost of not over 25 cents each for decorating meters, in addition to what you are now paying; and you will get more than your money back the first year in the increased confidence which such meters command. I know this from experience. Some years ago Trinity College erected new buildings in the city of Hartford, and as the meters were arranged to sit in the hallways, they wanted them to look well. I ordered meters enough to supply the buildings, so that every section might have a meter, and had them decorated. We could not get a black meter put into anybody's house or basement after these had been seen, and we have not made the effort. When any of our meters, that were formerly black, need repairing, they are decorated when they come back from the factory. This has proved of very great value to us. Years ago I promised Mr. McDonald, at his request, that I would say nothing about it, and you will bear me evidence, brethren, that I have not. (Laughter.) I go on the principle that there are no secrets in the gas business—particularly between gas managers; and this ought not to be a secret. It is no violation of confidence or breach of good faith to speak of it as I have done here and elsewhere; and as Mr. McDonald has already condoned the offense I feel justified in alluding to it here. I think that is the only omission he has made in his statement—that it does not call attention to the importance of decorating meters; because it is of real practical value in the degree of confidence which it gives the consumer in his possession of a first-class article. It will not make so much difference about the internal arrangements of a meter; we know that they are all right, and of course we believe what the meter says, and we expect to be believed when we make statements; but I am sure that decorated meters will prove an advantage to every company that introduces them.

Mr. McDonald—I want to say a word before this subject is passed. I have, as you know, given quite a number of dates in this paper, and I realize that some of them may be wrong. Therefore if those who are interested in having the dates exactly correct will let me know of any errors before the paper finally goes into the archives, I will see that the corrections are made.

Mr. Somerville—I am sorry there is not a little more debate upon this interesting paper. Mr. McDonald mentions a new subject that has come before the Association. I refer to the prepayment meter. I was in hopes we would have some debate upon this, to us, a new idea. I would like to hear what the members have to say about this thing, whether they consider that prepayment meters would be good things for their districts, if they are intending to put them in, and what the prospects are. I have an idea that in some places prepayment meters would be an excellent thing. It seems a good thing to me that a man can purchase his gas as he purchases his oil; so that if he wants 25 cents worth of gas he puts 25 cents in the slot, and gets his gas. Surely this is a new idea, and I was in hopes we would hear something about it. I hope Mr. Chollar will tell us about this Yankee invention that Mr. McDonald hinted at. We were talking over the thing—I had an idea and he had an idea—and I would like Mr. Chollar to describe this invention of his. He says that it is unpatented; but he is a philanthropist, as we all know, and I trust he will let us hear about it.

Mr. Chollar—I spoke with Mr. Somerville and two or three other gentlemen yesterday about a little contrivance that we are attaching to one or two gas meters for the purpose of finding out something about unexplained gas bills. It is a little electrical attachment to the meter, connected with a recording apparatus—a clockwork arrangement, whereby every 5 feet of gas that is registered on the meter pricks a little hole in a paper—the paper being moved by clockwork so as to leave a record not only of the amount of gas consumed, but also of just when it was consumed. It is intended to explain not only leakages, but to betray a lot of little secrets that the gas consumer does not know anything about. We have just completed a couple of the devices, but have not yet put them in practical operation. It has occurred to me that the same or a similar arrangement might be applied to the slot meter by means of an electrical attachment, so that dropping a nickel in a slot upstairs would start the meter in the cellar.

On motion of Mr. Odiorne a vote of thanks was tendered to Mr. McDonald for his interesting and valuable contribution to the history of gas meters.

The President—The next paper is that by Mr. Irvin Butterworth, on

STREET MAIN PRESSURE.

The conditions constituting a proper distribution of gas in respect to street main pressure have long been well recognized and understood. They demand, simply and briefly, the maintenance, within reasonable limits of fluctuation, of a constant and moderate pressure, night and day, in the house pipes of every consumer.

The means by which these conditions may be fulfilled are also well known. They consist of proper locations of works with reference to territory supplied, large street mains, special "feed" mains to low and remote districts, district holders, station and district governors, pressure regulators at consumers' meters, governor burners, etc. There are no insurmountable mechanical or physical difficulties in the way of securing a proper distribution of gas under practically any conditions of location or topography.

But, notwithstanding the end sought to be attained, and the means thereto, are so well understood, it is, I fear, nevertheless, unfortunately the fact that the distribution of gas in most cities is accomplished in a more or less crude and imperfect manner. Of course, absolute nicety and perfection of pressure conditions are unnecessary, even if they were possible, which they are not; but, as above stated, a moderate and practically uniform pressure, throughout all hours of the day and night, and in the entire city or district supplied, is not only desirable, but possible. Just whether any particular company is warranted, from economic considerations, in incurring the expense necessary to secure this result, or how much money they should expend in approximating it, is a matter depending, like so many others in our industry, upon local conditions. Each gas company should study its own distribution conditions thoroughly, take a broad view of the subject, and do whatever is for its own best interests "in the long run," remembering that they are not in business for one year or ten years, and that when their output shall have outgrown their distribution system they cannot remove to another city. But it seems to me that the importance of the subject of street main pressure is not as well recognized as it should be. It appears to have been laid on the shelf. As far as I can find, no special treatment has been accorded it in the gas journals or gas association meetings for a great many years. It has occasionally been mentioned incidentally in connection with the subject of unaccounted-for gas, but it seems to have been assumed that nothing further can be added, or needs to be added, to the present stock of knowledge concerning it. The result of this, in my opinion, is that its importance is apt to be forgotten and the whole subject neglected, both in theory and in practice. It is to call attention to this danger and emphasize the importance of the subject, rather than to add anything new or valuable to what is already known thereon, that this paper has been written.

It must be remembered that conditions respecting street main pressure have undergone some changes in recent years: (1) The increasing use of gas for fuel necessitates a higher pressure, especially in the daytime, than formerly; (2) the necessity for effecting all possible economies in order to meet increasing competition and the demand for a lower selling price, has greatly increased during the past decade; and (3) crudities and imperfections in distribution that were tolerated by consumers with equanimity in the early days of gas lighting and even comparatively recently, now irritate and fail to satisfy them, as they become more and more accustomed to the luxuries, comforts and mechanical refinements and perfections of modern civilization. Therefore, it seems to me that we might profitably give a few moments' special attention to this subject, as old as the gas business itself, in the light of these new developments.

Bad conditions as to street main pressure injure a gas company in two ways: First, directly, without the knowledge of the consumers, by increasing the company's actual leakage; and, second, indirectly, by causing the consumers inconvenience and dissatisfaction, and thereby diminishing the use of gas. In my judgment the latter source of injury is much more important than the former.

The fact that high street main pressure increases leakage needs neither mentioning nor demonstration; it is well known and self-evident. But it is the actual and not the percentage of leakage that is increased by high street main pressure. Experiment and calculation have shown that the escape of gas through an orifice, and therefore the amount of actual leakage, is in proportion to the square root of the pressure. Suppose now a gas company that sells 200,000,000 feet per year at $1 25 per thousand, and whose actual leakage is 20,000,000 feet per year, at an average street main pressure of fifteen-tenths, should, in order to supply gas stoves satisfactorily, on account of small street mains, increase their average pressure to twenty-tenths. Their actual leakage would increase in the ratio of 3.87:4.47 (the square roots of 15 and 20 respectively), and the increase would amount to 3,101,000 feet annually. If their gas costs 60 cents in the holder, this increased leakage would mean a loss of $1,860 per year, or 6 per cent. interest on $31,000. In other words, if their consumption would not also be increased by the increased pressure they could better afford to invest $31,000 in larger mains than to increase their pressure this half inch. As their consumption would be increased, however, let us see how much the increase must be in order to wipe out this loss. Assuming that the cost of distributing this extra gas sold is one-half its cost in the holder, the total cost per 1,000 feet sold would be 90 cents, leaving 35 cents net profit per 1,000 feet. Dividing the annual increased loss through leakage, $1,860, by this profit per 1,000, gives 5,316,000 feet as the increased sales necessary to be obtained annually in order that the company might barely come out even in their experiment. As a matter of fact, however, if the consumers would all leave their burner keys open as wide as they were before the pressure was increased, and make no change in their burners, I think I am correct in saying that the consumption, or sales, would increase in exactly the same ratio as would the leakage; for, notwithstanding the effect of the increased pressure upon the leakage is exerted throughout all hours of the twenty-four, whereas the consumption of gas would get the benefit of it during only the four hours, say, in which the great bulk of it occurs, yet, if the quantity passing the burners at fifteen-tenths pressure during a certain number of hours each day should aggregate a certain quantity for the year, then increasing the pressure to twenty-tenths and leaving all other conditions unchanged would certainly result in increasing the consumption in the ratio of the square roots of these two pressures, just as the leakage increased. In the supposed case sales would increase 31,007,750 feet per year, or 10 feet for every 1 foot increased leakage; and for every 60 cents that the company would lose through increased leakage it would make $3.50 (10x35 cents) through increased sales. This is under the supposition, as above stated, that consumers would not change their burners or the adjustment of their burner keys; but, as a matter of fact, it is hardly possible that a gas company who are giving a majority of their consumers adequate service at an average street main pressure of fifteen-tenths could increase it to twenty-tenths without obliging a very large proportion of them to reduce the openings of supply to their burners, so that, in those cases, no more gas would pass than formerly. It is safe, I think, to estimate that the sales would not increase more than 5 feet where the leakage would increase 1 foot, which would mean a gain of $1.75 for the loss of each 60 cents. But I assumed above that the expense of distributing this increased sales would be the same per 1,000 feet as that of the previous sales, which, however, would not be the case. There would be no additional meters, meter readings, nor book accounts, and, in fact, no items of increased distribution cost whatever. Therefore the cost of this extra gas sold should be figured the same as that in the holder, and hence the profit would be 65 cents per 1,000 feet instead of 35 cents; or for every 60 cents lost through leakage the company would gain $3.25 through increased sales, or a net gain of $2.65 for every 1,000 feet lost through the increased pressure. There would be 3,101,000 feet so lost, and multiplying this by $2.65 gives $8,217 as the net increase in the revenues of the company for the year, due to increasing their average street main pressure from fifteen-tenths to twenty-tenths, provided I have made no error of calculation or assumption, and overlooked no factor entering into the problem.

This is, of course, an extreme case, but it will serve as an illustration of how each gas manager may, for his own information and guidance, figure the problem for himself, based on his own conditions. He will be convinced, I think, that the immediate and direct effect of increase of pressure, up to a point where consumers would check the flow of gas through their burners, would be to augment the revenues of his company. Beyond this point, of course, it would decrease them, since leakage would continue to increase while sales would remain stationary.

I do not want to be misunderstood as believing that a gas company should carry the maximum pressure consistent with a satisfactory delivery of gas at the consumers' burners; on the contrary, gas should be distributed at the lowest possible pressure compatible with good delivery. I have always assumed that gas companies carrying the highest street main pressures would have the largest percentage of unaccounted-for gas, and, conversely, that a sure way to help keep down your percentage of unaccounted-for gas was to carry low pressures. This would be true if very high pressures were carried; but from reports which I have received from 120 gas companies (to whom I now desire publicly to express my thanks) I am forced to the conclusion that, within the limits of pressures carried in modern practice, street main pressure does not bear any relation to unaccounted-for gas in terms of percentage of gas made, or if so the effect of the pressure is neutralized and overcome by other influences. From reports sent me I have compiled the two tables given herewith.

It will be seen that the street main pressures (at the works) of the 20 companies having the lowest percentage of leakage average a little higher than those of the 20 companies having the highest percentage of leakage. As the pressures average about the same for both, however, it is evident that there is no apparent relation between percentage of unaccounted-for gas and street main pressure, and that the difference in these percentages must be accounted for by other circumstances.

TWENTY GAS COMPANIES HAVING THE LOWEST PERCENTAGE OF LEAKAGE.

Reference No. of Gas Company.	Process of Manufacture.	Population, in Thousands.	Annual Output, in Millions.	Works Pressures.				Percentage of Leakage.	Leakage per Mile of Main per Year.
				Max.—Night.		Day.			
				Winter.	Summer.	Winter.	Summer.		
1	C. & W.	18	44	47	37	18	18	6	100,000
2	Coal.	50	60	22	20	10	10	6.27	149,900
3	C. & W.	250	575	35	30	17	17	4	142,000
4	Water.	25	28	19	19	14	14	5.08	112,200
5	"	43	65	21	21	21	21	4.81	94,437
6	"	25	55	22	22	22	22	5.3	....
7	C. & W.	185	325	28	28	18	18	4.95	....
8	"	300	900	30	30	20	20	5.5	....
9	Coal.	50	90	35	35	25	25	5	75,000
10	"	20	28	20	18	15	12	6	45,828
11	C. & W.	90	143	30	30	20	20	5.65	168,286
12	Coal.	26	40	26	26	26	26	5.4	109,290
13	C. & W.	182	330	20	18	10	10	6.25	132,200
14	Coal.	300	600	20	15	12	12	5	200,000
15	Water.	74	57	30	25	20	20	6.5	150,000
16	Coal.	80	254	25	23	18	18	5.1	162,900
17	C. & W.	15	25	20	20	20	20	5	....
18	Coal.	25	33	25	20	15	15	2	....
19	C. & W.	45	100	32.5	25	25	25	6.58	166,150
20	Water.	206	300	25	25	25	25	6.6	....
7C., 8 C.W., 5 W. Average.		100.5	202.6	26.12	24.35	18.55	18.40	5.36	*129,142

*Average of 14.

TWENTY GAS COMPANIES HAVING THE HIGHEST PERCENTAGE OF LEAKAGE.

Reference No. of Gas Company.	Process of Manufacture.	Population, in Thousands.	Annual Output, in Millions.	Works Pressures. Max.—Night. Winter.	Works Pressures. Max.—Night. Summer.	Works Pressures. Day. Winter.	Works Pressures. Day. Summer.	Percentage of Leakage.	Leakage per Mile of Main per Year.
1	Coal.	38	53	15	15	15	18	14	303,000
2	"	40	146	26	26	16	16	15	400,000
3	"	75	65	24	24	15	15	15	416,000
4	"	57	70	22	22	15	15	13	248,623
5	"	15	17	18	15	12	10	17	209,592
6	"	40	34	22	15	22	15	20	300,000
7	"	11	16	32	30	25	20	16.5	239,000
8	C. & W.	35	35	22	18	22	22	14	300,000
9	Coal.	23	25	25	25	15	18	19.5	....
10	C. & W.	120	300	28	24	16	16	14.2	....
11	Water.	46	70	28	26	18	18	19	415,000
12	Coal.	60	92	24	22	11	11	14	269,000
13	C. & W.	150	275	24	20	17	15	18	385,000
14	Coal.	17	30	22	22	15	15	18.2	244,660
15	"	285	530	30	30	25	25	19	....
16	"	50	70	40	40	10	10	20	....
17	C. & W.	40	50	22	20	12	10	23.5	343,000
18	"	1,200	3,391	36	36	25	25	14.6	572,218
19	"	42	55	32	32	14	14	15	....
20	Coal.	60	44	29	29	23	23	13.3	94,149
13 C., 6 C. W., 1 W. Average.		*63	108	26.05	24.55	17.15	16.55	16.64	†315,950

*Average of 19. †Average of 15.

TOTALS AND AVERAGES.

Twenty Companies Having	Process C.	Process C. & W.	Process W.	Population, in Thousands.	Annual Output, in Millions.	Works Pressures. Max.—Night. Winter.	Works Pressures. Max.—Night. Summer.	Works Pressures. Day. Winter.	Works Pressures. Day. Summer.	Average Pressure.	Percentage of Leakage.	Leakage per Mile of Main.
Low leakage	7	8	5	100.5	202.6	26.12	24.35	18.55	18.40	21.85	5.36	129,142
High leakage.	13	6	[illegible]	[illegible]	[illegible]	26.05	24.55	17.15	16.55	21.07	16.64	315,950

It will be noticed that the cities and output average much the largest in the case of the 20 companies having the lowest percentage of leakage. This doubtless accounts for a great deal of the difference. It is manifest that street main pressure bears a direct relation to the actual leakage per mile of main; but since in ascertaining the above leakages per mile of main no account was taken of the size of the mains in any instance, this gives the largest companies much the advantage in the above comparison. If the mains had been reduced to a certain fixed size, say 3 inches, before making the calculation, the leakage per mile of main of the large companies would not be relatively so small. Again, it must be remembered that in large and compact cities, with consumers close together, the percentage of leakage should not be so high as in the smaller cities, with scattered consumers and a low ratio of output to main mileage.

I admit the possibility, however, that it may not necessarily follow that because the average pressure at the works is about the same in both the large and the small cities, the street main pressure throughout the cities themselves is therefore the same in both sets of cities. In fact, it is probable that the average street main pressure throughout the smaller cities is higher than in the larger cities; but I doubt whether there is a material difference.

I have also noted the different processes of manufacture, and ascertained that of the 20 companies having the highest percentage of leakage, 13 of them make coal gas exclusively and only 1 water gas exclusively; whereas, in the case of the 20 companies having the lowest percentage of leakage, only 7 make coal gas exclusively, while 5 manufacture all water gas. This may or may not indicate that there is less condensation of water gas than of coal gas. The greater gravity of the former would hardly reduce its percentage of actual leakage.

Of the 40 companies, 16 mentioned the material used by them for making joints. Eight of these 16 companies were "low leakage" and 8 "high leakage." Of the former, 4 use lead joints and 4 cement joints exclusively; of the latter, 6 employ lead joints and 2 cement joints exclusively. This may possibly mean a slight advantage in favor of cement joints.

It is apparent, however, that the percentage of unaccounted-for gas is the net or aggregate result of very many influences and circumstances, and that street main pressure is not dominant among them. There are so many conditions and factors entering into the question that it furnishes a most interesting and complex study in the relation between cause and effect. It is hard to say "Lo here" or "Lo there" in assigning causes for leakage. For instance, in reports from 14 companies having a *low* leakage the following causes therefor were assigned the number of times indicated:

Frequent barring over mains for leaks	8
Deeply laid mains	7
Good soil	5
Low street main pressure	4
Well laid mains	4
Correct station meter	3
Frequent testing of consumers' meters	4
Thorough condensation	3
Large mains	3
Level territory	3
New mains	2
Good street main governor	2
Mains and services steam-tested before laid	1
Services "pitched"	1
Governor burners on street lamps	1
Careful attention to time of lighting and extinguishing street lamps	2
Well fixed water gas	1
Sold at higher temperature than at station meter	1
New meters	1
Output large per capita	1
Small mains (6 inches and under) wrought iron	1
Sewer work watched	1
Mains laid in soil full of water	1
New services	1
New sewers	1
Mains on each side of street	1

Total number of causes mentioned, 26

In reports from 14 companies having *high* leakage the following causes therefor were assigned the number of times indicated:

Scattered consumers	6
High pressure on account of gas stoves, etc	5
Small mains	5
Bad mains	4
Hilly territory	3
Bad service pipes	3
Bad soil	2
Sewer building	2
Shallow mains	2
High pressure to fill district holders	2
Concrete pavements, preventing detection of leaks	1
Electrolysis	1
No district governors	1
"Dead-head" consumers	1
The laying of street pavements	1

Total number of causes mentioned, 15

[illegible] no matter what the conditions [illegible]

[illegible] determine what that pressure should [illegible] that it should be the minimum [illegible] at the consumers' burners. [illegible] matter of opinion largely and of local conditions [illegible] differ among themselves in their [illegible] pressure in the house pipes: [illegible] higher pressure than do their [illegible] states that "the pressure [illegible] lighting and heating is about eight- [illegible] pressure at the meter, it would [illegible] American conditions [illegible]

[illegible] would be considered by the [illegible] pressure. Assuming this to be the [illegible] up or down, from this pres- [illegible] company. I do not mean simply an [illegible] uniformly high or a uniformly low pressure [illegible]

Probably no gas company is guilty of the short-sightedness of maintaining pressures lower than their consumers want or need, but in every city there are some low or remote points that are liable to be inadequately supplied. If so, the pressure at these points should be immediately reinforced. No concern can hope to retain their business who are unable to fill their orders. Consumers want more light now-a-days than formerly, and if the gas pressure is insufficient they are driven to other means of lighting.

But the tendency and temptation are toward the other extreme of high pressure. This causes excessive gas bills, dissatisfied consumers, "blowing" gas burners, and in general an object lesson in gas lighting that greatly discredits its efficiency and economy.

Varying and irregular pressures are not only the worst, but unfortunately the commonest of distribution evils. Flames that flicker and are too small during the early hours of the evening and that "blow" at 10 o'clock do the gas company and its business incalculable damage. I have heard of gas jets in a sitting room that had to be adjusted and readjusted at least four times during a single evening to take up variations in pressure. Under an increase of pressure from one to two inches, the flame from an ordinary lava tip increases nearly 50 per cent. in size, and on many a social occasion has the sudden cracking of a gas globe, due to increasing pressure as the evening advances, startled the guests, while the hostess, annoyed and mortified, apologizes, and the host, condemning the gas and the gas company in terms more or less emphatic, rises and turns the gas key, all eyes watching him meanwhile, the conversation during the interruption doubtless turning upon the superiority of electric light, or the latest gas meter story is related. The guests may possibly never think of the occurrence again; but it has left an indelible impression upon their minds nevertheless, and if I did not have complete confidence in the enduring vitality of gas lighting I would be tempted to say that the episode was "another nail in its coffin."

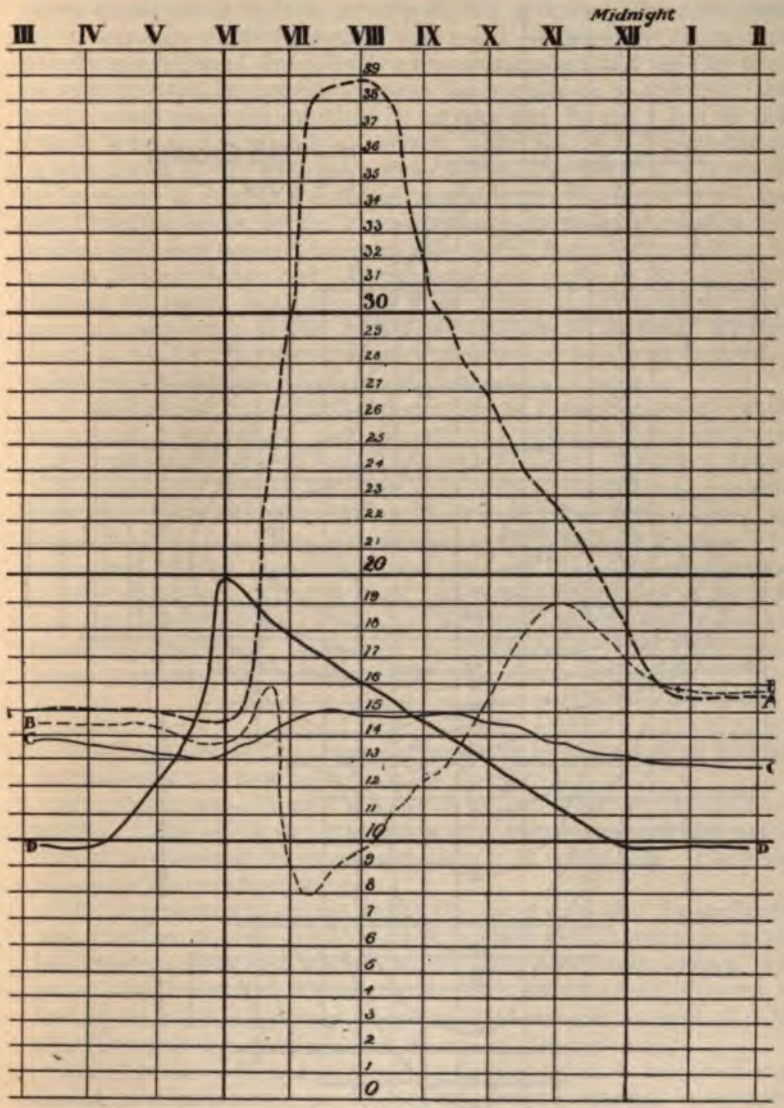
The consumer notices and suffers the inconvenience and annoyance of insufficient, excessive or irregular pressure long before he complains to the company, and during all that time he is being unconsciously educated to regard gas lighting as a crude, imperfect and unscientific method of illumination. This education may be slow and slight, but it is enough to decide him against gas when a new light is offered him.

Bad pressure conditions are to be avoided, not because they hurt the company, but because they hurt the consumer. It should be the ambition of every gas manager to maintain a street main pressure so regular, moderate and correct that his consumers should never know that there was any such thing as pressure. Like the healthy laborer who is never made to know that he has a stomach, so should gas consumers never have their attention called to the existence of pressure.

The accompanying chart is a comparison of good and bad pressure conditions. It is made up from actual pressure sheets obtained from two comparatively large gas companies, operating under practically the same conditions as to location of works with reference to territory supplied, business character of population, topographical conditions, etc. (See pages 363 and 364.)

The dotted lines A B represent pressure in city No. 1, and the solid lines C D in city No. 2. The heavy lines show pressures at the outlets of the station governors; the light lines represent pressures taken simultaneously in each case with those indicated by the heavy lines at points remote from the works and where the pressure was weakest at the time of maximum consumption. It will be seen that in city No. 1 a pressure of thirty-eight tenths at the works was necessary to prevent the pressure from dropping below eight-tenths at a point remote therefrom, making a range of thirty-tenths; while in city No. 2 only twenty-tenths pressure at the works was necessary to hold the lowest pressure at a remote point, at the time of maximum consumption, up to thirteen-tenths, a range of only seven-tenths. It should further be said that the pressures shown for city No. 1 were taken in April, while those of city No. 2 were taken in February, when, on account of larger consumption, the difference between maximum and minimum pressures would naturally be greater than in April. City No. 2 is therefore at some disadvantage in this comparison. The pressure conditions in city No. 2 are, however, almost ideal. A consumer, in whatever part of the city he might be, would notice no fluctuation whatever in his lights, which would burn at their maximum efficiency at all times. On the other hand, in City No. 1 the pressure conditions are bad. A consumer near the works would have "blowing" burners at the same moment when the suburban resident would himself be "blowing" the company up for not putting on more pressure! The only difference in the conditions having a bearing on this comparison is that the gas mains in city No. 1 are small, while those in city No. 2 are large. I might say, incidentally, that in city No. 1 the unaccounted-for gas is 11 per cent. of the make, while in city No. 2 it is only 5 per cent., showing, I think, that the mains in city No. 1 are not only too small but not very tight.

As conditions affecting street main pressure are not alike in scarcely any two cities, no general or hard-and-fast rule can be laid down as to how proper pressures may be maintained. Each company must study its own conditions and necessities in this matter and apply the remedies necessary in its own case. Pressures should be carefully taken, by means of recording gauges throughout the distribution system, under the same volume of consumption, and a chart constructed showing lines of equal pressure throughout the city at the time of evening when the rate of consumption is greatest. This will disclose, in a very graphic manner, the weak points needing attention. Such a chart is illustrated in this paper.


Midnight
III
IV
V
VI
VII
VIII
IX
X
XI
XII
I
II
39
38
37
36
35
34
33
32
31
30
29
28
27
26
25
24
23
22
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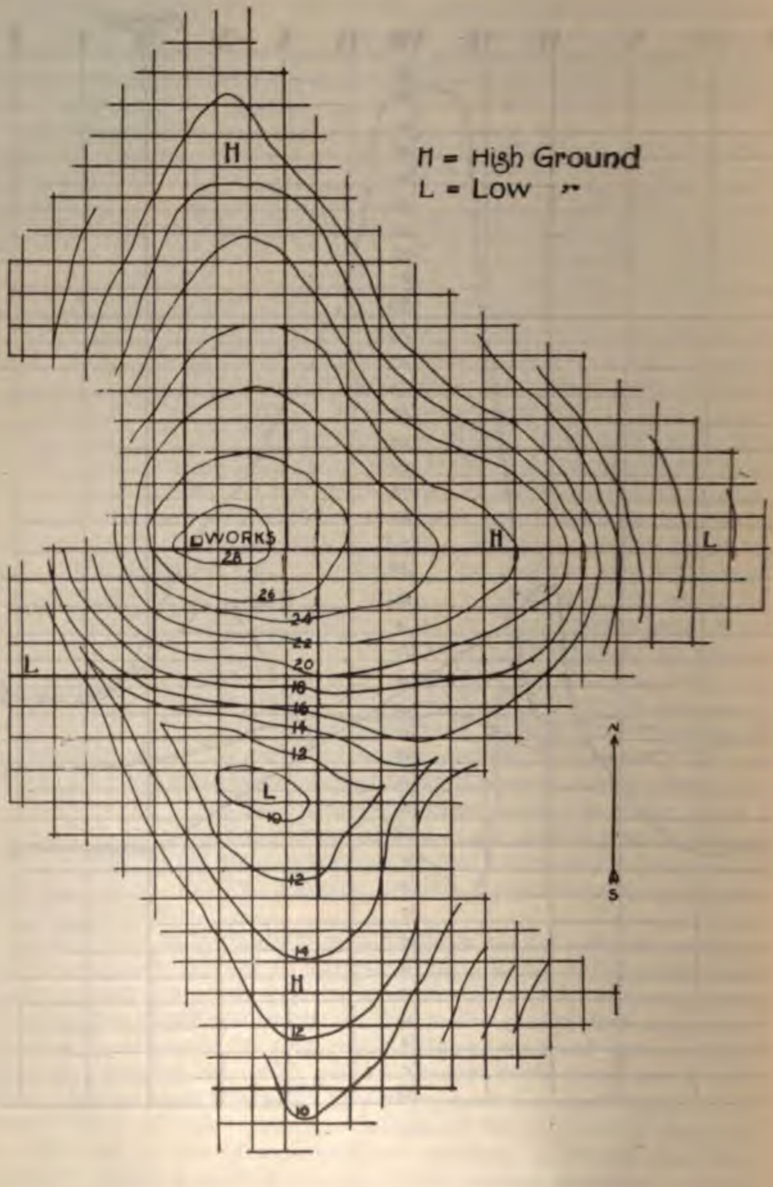

H = High Ground
L = Low ,,
H
WORKS
28
26
24
22
20
18
16
14
12
L
10
12
14
H
12
10
H
L
L
N
S

This chart would indicate that the city has small and insufficient street mains and is built upon very uneven ground. The difficulties to be overcome would be greater than usual. If the street mains were exactly proportioned throughout to the consumption and the city were on level ground, an automatic street main pressure governor at the works would solve the problem to an absolute nicety. But in this case it is evident that such a governor, while just as indispensable as in any, could hardly maintain proper pressure conditions. It would be necessary to enlarge the mains, run special "feeders" to the low and remote districts, so that lower pressures could be carried at the works, and cross connect them into the lateral mains when the low or remote territory is reached; district governors might be placed to advantage on mains supplying the high points, and in extreme cases pressure regulators at the consumers' meters or governor burners could be used. The use of district holders as a means of equalizing pressures is condemned by some engineers.

A desideratum in the distribution of gas is a good automatic pressure governor that can be placed under the street on a line of lateral distributing main leading from a special "feeder" containing gas at high pressure. Another desideratum is a cheap and efficient pressure regulator to place at consumers' meters, those now on the market being expensive and liable to derangement. And still another is a cheap and efficient governor burner, that will not clog with dirt and require attention. But with such means and appliances as are now available every city can be supplied with gas under proper pressures throughout and during all hours of the twenty-four. Will it not repay every company to incur the expense necessary to do this?

DISCUSSION.

The President—The paper just read was most interesting indeed, and the subject is now before you for discussion.

Mr. Thompson—Toward the end of his paper Mr. Butterworth remarks: "The use of district holders as a means of equalizing pressures is condemned by some engineers." I would like to ask the reason for the condemnation.

Mr. Butterworth—I am under the impression that the engineers who condemned the use of district holders did so because, as the holders were connected with the mains of the distribution system, they were obliged to maintain a high pressure; and one man objected to having the holders scattered, claiming that the holders ought all to be near the works so as to be under the eye of the engineer.

Mr. Russell—In connection with this question it has been suggested that engineers in laying gas mains attempt to connect their pipes up to existing sizes, and continue them on at the same size, notwithstanding they have an increased consumption on that line, and will have further to distribute, while other conditions remain practically the same. The excuse has been brought forward that anything of that sort requires a great deal of computation, and that the conditions are not favorable to their getting things just right. Mr. Cox has gotten up an apparatus which I have been asked to show to the Association. He has not been able himself to attend and explain it. It is a very handy thing. Of course some corrections will have to be made, because there is no allowance made for difference in elevations. All its computations are very readily ascertained. I have the instrument here. I think most of us are acquainted with it, as it was described in the last issue of the *American Gas Light Journal.* While I do not make any point on the thing particularly, I thought some of you would probably like to have a look at it and be able to get over some of your troubles in that way.

THE PRESIDENT—If Mr. Russell will leave this instrument on the table each one who desires to look at it will have an opportunity to examine it after the adjournment. Has any gentleman anything further to offer on this subject? If not we will pass to the next subject —after thanking Mr. Butterworth on behalf of the Association for his valuable paper.

THE PRESIDENT—The next business will be reading the various contributions to the

WRINKLE DEPARTMENT

which will be presented to the Association by Mr. George Treadway Thompson, who edited the same.

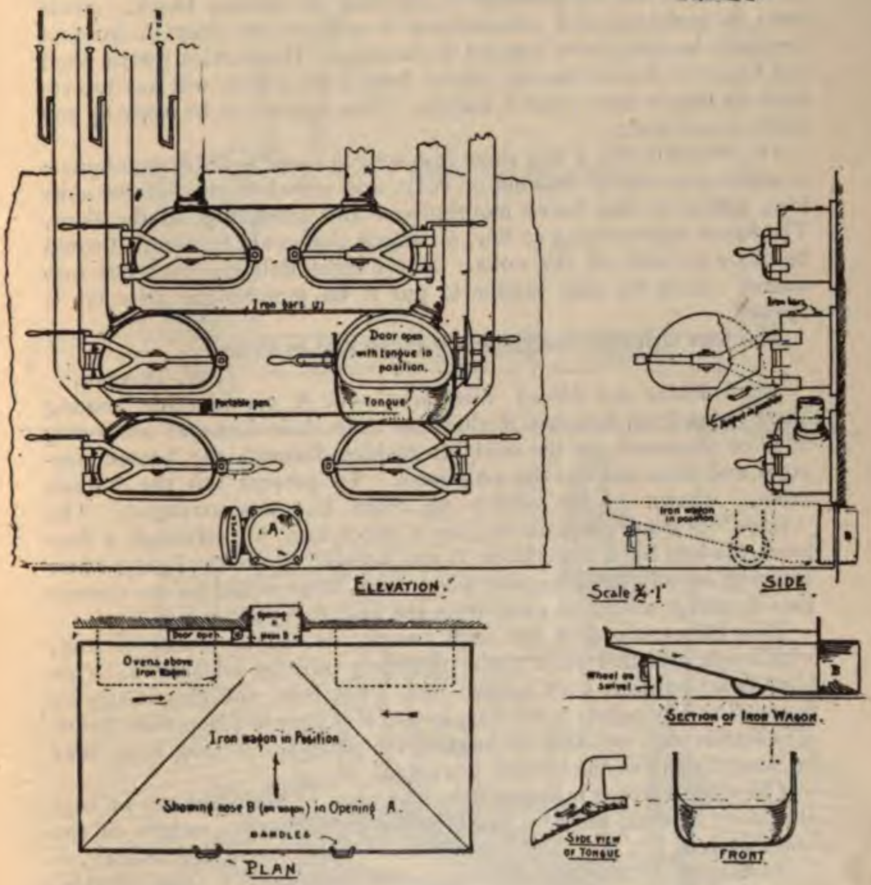
Mr. Thompson read as follows:

Some Retort House Devices.—I. It is unnecessary to enumerate the many evils attending stopped stand-pipes, which in our works have been reduced almost to a minimum by the introduction into stand-pipes of a small amount of water continually dropping. The arrangement for its accomplishment is simple, as seen by the accompanying sketch. In order for it to be effective the pipes must be clean at the commencement, and the water allowed to run so as to produce a very rapid dropping.

II. It adds much to the appearance of a bench of retorts if the lids are free from tar due to the removal of the tarry matter which has collected in the mouthpieces. This may be accomplished by laying two iron bars across the top of mouthpieces, upon which rests a portable pan into which the pitchy matter may be raked before coke is drawn.

III. Wrinkle No. 3 is an iron coke chute wagon into which the coke from bottom retort may be drawn, and from it pushed into the

WRINKLE DEPARTMENT,
PLATE I.



furnace. It is made to extend, when in position, the width of the bench and out from bench about 4 feet. It slants toward the nose, which fits into furnace block, making it a very easy matter to introduce hot coke direct from retorts into furnace. The bed is mounted upon three wheels, and by proper adjusting may be raised or lowered so as to meet the requirements of opening in furnace block. Aside from its usefulness and convenience it enables the floor in front of bench to be made level instead of slanting. The bottom retorts need not be over 16 or 18 inches above floor level, which will put top retorts no higher than 5 feet 6 inches. This wagon can be made by any sheet iron worker.

IV. Wrinkle No. 4 is a sheet iron tongue made to fit on mouthpiece of retort previous to drawing of coke, and serves to prevent the coke from falling on the lower mouthpieces and scattering on the floor. The lower retorts being so low, no wagon that could be dumped could be made to catch all the coke. The tongue delivers coke out into wagon. It is an easy matter to put it on mouthpiece after lid is opened.

The four wrinkles described are illustrated in Plate I.

J. W. Dunbar.

Stack Valve for Bench Chimneys.—V. A considerable cooling effect is made on benches during the time their furnaces are being filled or clinkered, by the cold air rushing through the heated passages and flues and out the chimneys. To prevent this the "stack valve," shown in the sketch on Plate II., was arranged. The "valve" is simply a plate of ¼-inch sheet iron, for although a fire-brick tile had been thought of, it was decided to use the lighter cover as being equally safe, because when down there would be no current past it, and it would be away from the heat when not in use.

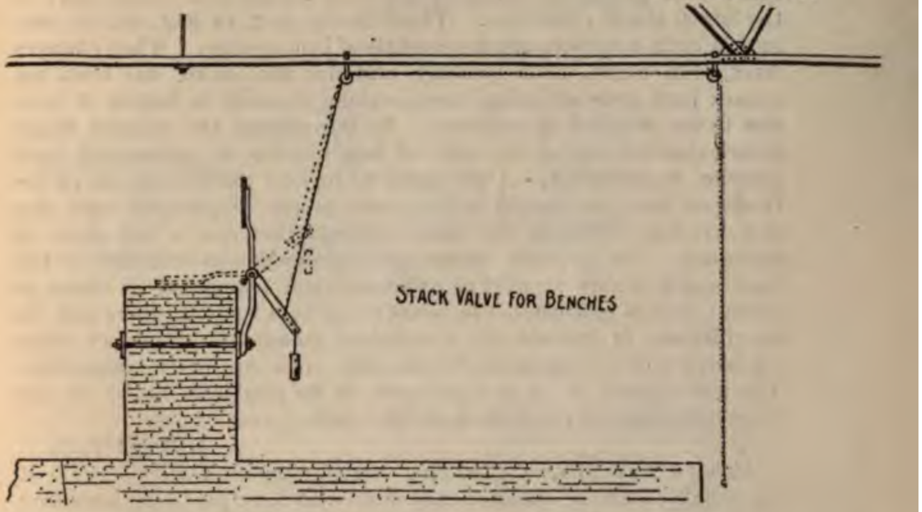
Two plates are used for each bench, riveted to pieces of iron, which are attached to a piece of ¾-inch pipe by set screws. One plate is set opposite each uptake flue. The lever and weight may be fastened at any point on the bar, so that it is easy to place them below a roof truss and use that for holding the pulleys. A long lever may be used instead of the pulleys if wanted.

The stack valve is made so as to stay open of itself, but can be kept closed by hooking the wire cord below or hanging a weight on the lower end.

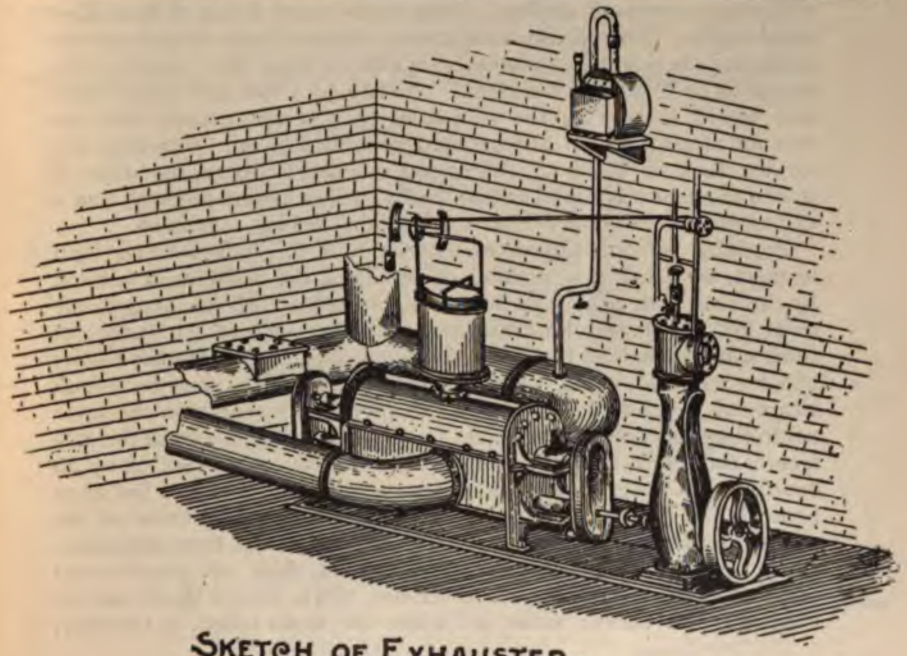
Arthur Finnegan.

Admission of Air for Reviving Iron Oxide.—VI. This wrinkle, illustrated in Plate II., is in use no doubt among many of you, but not by all. It serves to illustrate how easy and simple it is to introduce the required amount of air into gas (about 1½ per cent.) to assist in its purification. By its use the labor in changing purifiers is reduced with us about 90 per cent. We change but one box where 10 were necessary before the introduction of air, the time between changes being about 10 months instead of about 5 weeks. The pur-

WRINKLE DEPARTMENT.
PLATE II.



STACK VALVE FOR BENCHES



SKETCH OF EXHAUSTER.

ification of gas in the former case is near 20,000,000 cubic feet; in the latter, about 2,000,000. Three boxes, 12 x 12 feet, are in use, and in each box there are 200 bushels of iron sponge. When changes have been made, back pressure and not foul oxide has been the cause; back pressure being due to caking of oxide in bottom of box, due to the absence of moisture. By introducing the exhaust steam from exhauster engine into inlet of first purifier, an amount of back pressure is prevented. A dry meter to register the amount of air introduced into gas should not be used, as the diaphragms soon dry and harden, rendering the meter useless; therefore a wet meter is necessary. An ordinary meter cock connection is attached to the pipe which enters at inlet to exhauster, and connected to outlet of meter; and as exhausters are usually run at a vacuum, there will be no difficulty in introducing a sufficient amount of air, which when excessive can be regulated by the stop cock on meter connection. The introduction of 1½ or 2 per cent. of air produces, so far as can be ascertained, no diminution in the candle power of gas.

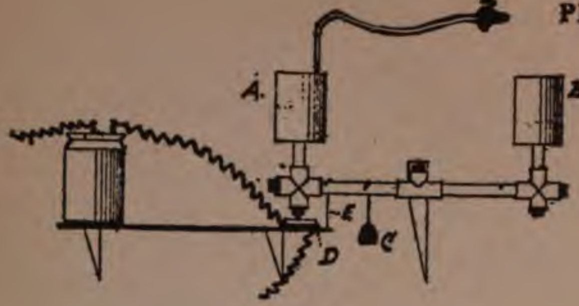
J. W. DUNBAR.

Using a Dry Meter, Admitting Air for Revivification.—VII. It has usually been the experience of those who have practiced admitting air at the exhauster inlet to ensure a partial revival of their oxide of iron within the purifiers, that a dry meter could not be used for measuring the percentage admitted, owing to the rapid drying of the leather diaphragms. This was also our opinion, confirmed by several successive instances wherein the anatomist of the meter shop had rendered the diagnosis of "cracked leathers." An old 3 x 3 foot wet meter which had served in proving the station meters was then pressed into service for measuring our nitrogenated oxygen, and our difficulty was for the time at an end. After some months, however, the drum of this instrument was found rusted badly, necessitating renewal, and a dry meter was reinstalled until a new drum could be obtained.

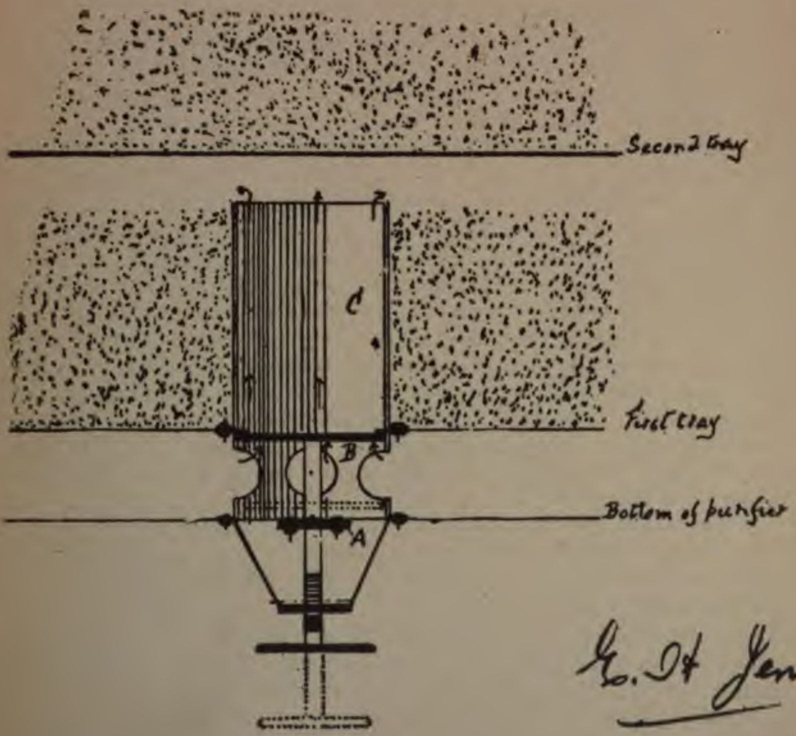
Profiting by our former experience and the bills for 200 light leathers, we tried this method of supplying the moisture demanded by the air. The inlet pipe to the meter, instead of reaching to the outer air, was turned down to within about an inch of the surface of some water contained in a galvanized vessel placed beside the meter, about 4 x 18 inches and 12 inches deep, into which passed a ½-inch steam coil, open at the lower end. A very small opening on the valve controlling this coil was sufficient to cause vapor to rise from the surface of the water, and any additional condensation was led off by an overflow. A cover loosely laid over the galvanized vessel, but open beneath the meter inlet pipe, ensured the proper direction of the vapor, and kept dust and other undesirable particles from the water.

The records of the meter manufacturer will show our purchase of the new drum referred to, in November, 1893, but we have not yet used it. The Glover meter set when the drum failed, in October,

PLATE III.



James L Ferrier



G. H. Jenkins

1893, is still in use untouched, and the problem of using a dry meter for this purpose seems effectively solved.

Geo. Treadway Thompson.

Signaling Excessive Vacuum at the Exhauster.—VIII. Materials required:

Two cans (old fruit cans will suffice), one open at top, the other closed.

Two ½ x 6-inch nipples, threaded on both ends.

Two ½ x 2-inch nipples, threaded on one end.

One ⅛-inch nipple, without threads.

Two ½-inch crosses, one ½-inch tee, five ½-inch plugs.

One electric bell outfit.

Solder a ½ x 2-inch nipple into the bottom of each can, and the ⅛-inch nipple into the top of the closed can. Fit the other nipples, crosses, etc., as shown in the sketch. Drill a hole through the square head of the plug in the tee, and balance the apparatus on a pin supported by a bracket, as shown in the drawing, Plate III.

An explanation of the working is almost superfluous. By means of the rider *C*, made from wire and lead, the arrangement is set at the maximum vacuum desired. Should this be exceeded, water will be drawn from can *B* to can *A* in sufficient quantity to depress the push-button *D* and ring the electric bell, which may be placed in any part of the works. *E* is a wire clamp which prevents the cans from being overturned should back pressure from any cause ensue.

It will be at once evident that such an arrangement may be used to signal pressure as well as vacuum. James Ferrier.

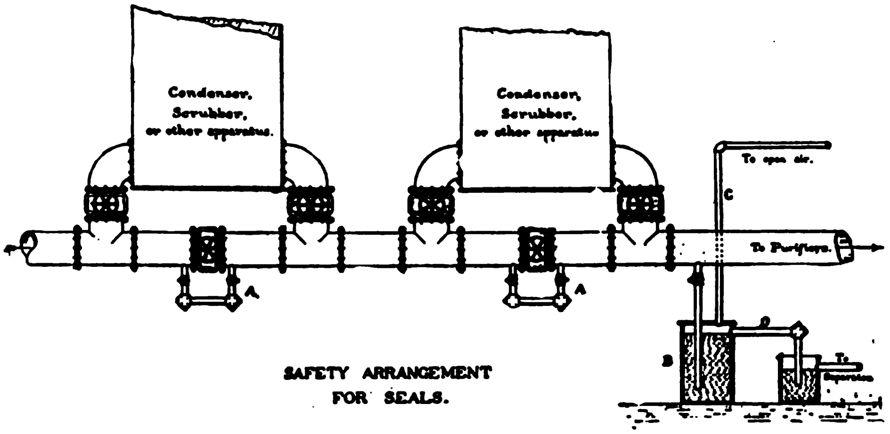
Safety Arrangement for Seals.—IX. The sketch (see Plate IV.) illustrates an arrangement whereby the use of open seal pots in connection with scrubbers, condensers and other gas apparatus, and consequently the danger of explosions due to gas blowing from seals in case of stoppages or high pressure, may be entirely avoided.

The tar and liquor condensed from the gas are simply trapped under the by-pass valves of the various apparatus by means of the trap pipes *AA*, and flow along the main gas-conducting pipe to one large closed seal pot *B*, opening from which are a blow-off pipe *C*, leading outdoors, and an overflow pipe *D*, for the condensed liquids. In case of high pressure or stoppages, gas can escape only outdoors through the vent pipe *C*.

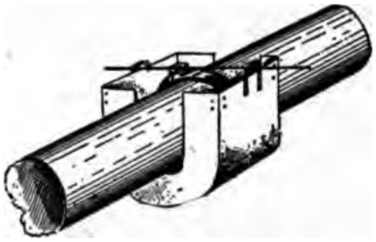
If the main gas-conducting pipe should not be level or grade throughout toward the seal pot *B*, drip pipes may be run directly from the low points to the seal pot. Irvin Butterworth.

By-Passing the Lower Tray of a Purifier.—X. Experience has shown that in purifying with oxide a purifier has often to be changed on account of back pressure, long before its purifying capacity has been exhausted. This back pressure is caused by the hardening of the oxide in the lower tray.

WRINKLE DEPARTMENT
PLATE IV.



SAFETY ARRANGEMENT
FOR SEALS.



The arrangement shown in the sketch, on Plate III., has for its object the prolonging of the life of a purifier by by-passing the lower tray, without the necessity of raising the cover. It consists, mainly, of a valve, the stem of which works through a stuffing box *A* on the bottom of the purifier, and the disc of which works in a flange pipe extending through the oxide in the lower tray. The flange pipe should be of the same dimensions as the connections of the purifiers, and it consists of two pieces, *B* and *C*. The lower piece *B* must be cast especially, as it will be seen from the sketch that the flange at one end extends into the interior of the pipe, and forms the valve seat. For the upper piece, *C*, a nipple of ordinary flange pipe may be used. In piece *B* holes are drilled for the passage of the gas, the size of these holes being governed by the size of the pipe.

The valve is represented closed, the dotted lines showing the position of the valve, and the arrows the course of the gas when the valve is open.

E. H. Jenkins.

Filter for Tar Well Overflow.—XI. All the tar, oil and water from the overflow of the tar well enters this filter through the inlet, to the bottom, and then passes up, filtering through the breeze, which takes out all the lighter oils and tar, leaving nothing but clear water to run out the overflow. A pump is inserted through the inlet pipe, by which the tar at the bottom can be pumped out. This filter not only saves the tar, but avoids the nuisance of its running into the main sewer, or open ditch, as the case may be. The device is illustrated in Plate V.

C. M. Keller.

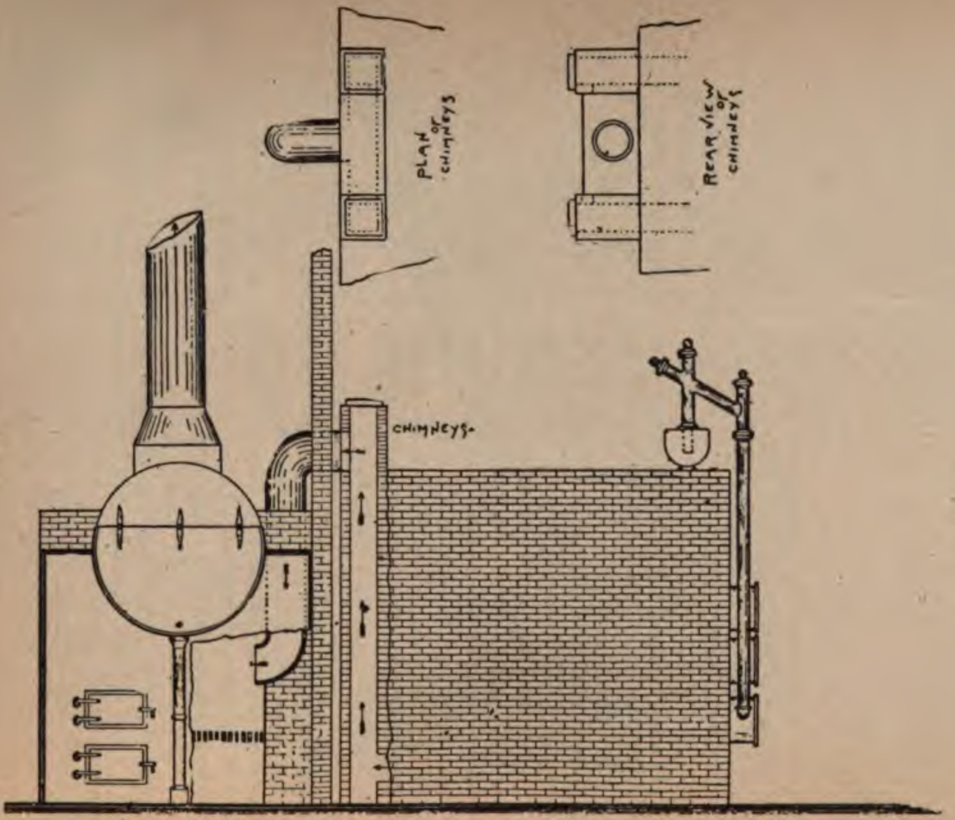
Using Bench Waste Gases Under a Boiler.—XII. In the use of this apparatus the waste heat of the retorts is brought under the boilers by connecting the two flues at the top of the bench and carrying the connection down the side of the boiler near the front. By bringing it down the side, as shown in the plans on Plate V., it does not interfere with the firing of the boiler in the least. No dampers are necessary whatever, except the dampers that are always used in the bench flues, and to regulate the draft. If the boiler is to be cleaned or the heat not wanted under it, you only remove the slabs on top of bench flues and allow the heat to escape in the old way.

C. M. Keller.

Basket for Melting Out Lead Joints.—XIII. Having occasion to remove some 200 feet of 12-inch main from its position on supports overhead in the works' yard, the device of which a description follows was adopted to avoid the labor otherwise necessary in cutting out the lead joints. The "basket" was formed from three pieces of old sheet iron; two of them, the end or front pieces, were alike, U-shaped, the inner semicircle fitting the outside of the main and the outer one being some 10 inches greater in diameter; the third was rectangular, about 18 inches wide, and bent to fit the outer edge of the front pieces, to which it was attached by "knees" of light iron.

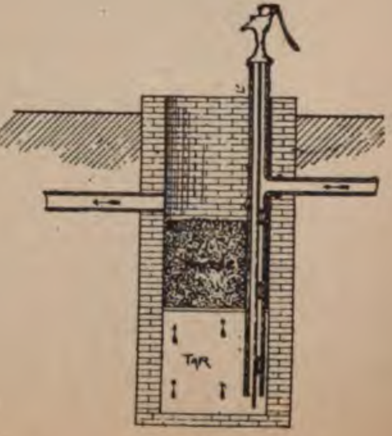
WRINKLE DEPARTMENT.

PLATE V.



WASTE RETORT HEAT APPLIED UNDER ELECTRIC LIGHT BOILER.

C. M. KELLER
COLUMBUS
INDIANA.



TAR FILTER

[illegible]

[illegible]

[illegible]

[illegible] this apparatus are [illegible] preferably [illegible] glass tube [illegible] is filled with large [illegible] First, meter No. [illegible] fifth, meter No. [illegible] and by-passes should [illegible]

[illegible] connected to the outlet of the [illegible] the exhauster, thus secur[illegible]

[illegible] manganese, or any [illegible] CO_2; while the [illegible] fed with a strong solution [illegible] the coke, coming in contact with [illegible] CO_2.

[illegible] comprehended. The foul gas [illegible] registered, thence to the [illegible] which it passes through [illegible] difference between the two [illegible] the gas passed. In like [illegible] and parting with its CO_2. [illegible] No. 3. The last reading subtracted [illegible] CO_2.

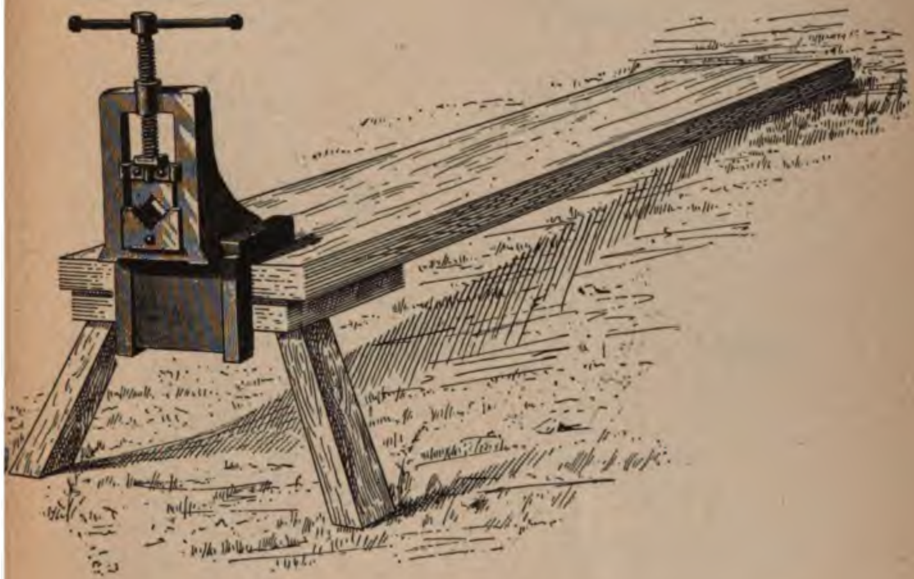
[illegible] description erected at Station [illegible] meters employed are [illegible] gas. It is obvious, however, [illegible] more easily regulated [illegible] each test the purifier and [illegible] of gas run through the [illegible] comparative accuracy.

O. O. THWING.

Portable Pipe Vise Bench.—XV. The following sketch shows a form of portable bench for a pipe vise, which has been used to good advantage in street work.

The vise is bolted upon a light plank, supported at one end on two removable legs, the other end resting on the ground. The bolts pass through the board which forms the bench top, and are secured by nuts beneath a smaller plank of oak or other hard wood.

B. E. CHOLLAR.

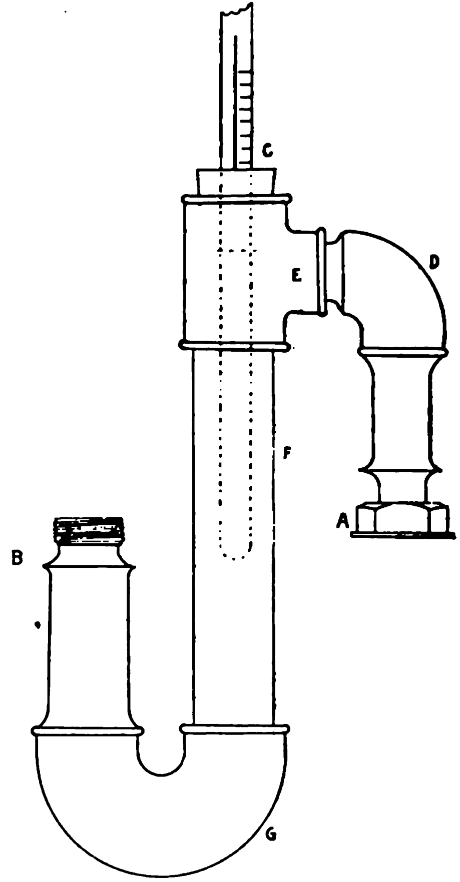


Taking Gas Temperatures at the Consumer's Meter.—XVI. As is shown in the drawing on plate VI., this apparatus is made up of a street elbow *D*, a tee *E*, a short piece of pipe *F*, and the return bend *G*. To these are connected by means of short pieces of lead pipe male and female meter unions. The thermometer is inserted by means of a perforated rubber stopper *C*. This may be easily and quickly connected to the outlet of a meter without changes in the connections, and will give accurate readings of the temperature of the gas passing through it.

H. W. DOUGLAS.

A Gas Gauge Float.—XVII. There was recently brought to my notice a device called the "Automatic Safety Signal for Steam Boilers." This great title referred to a very small glass bulb floating in the water gauge; the bulb, being colored red or blue, clearly indicated the level of the water within the boiler. An immediate extension of the usefulness of the idea was visible in its application to the gas gauges which abound in all gas works. Water colored with aniline and similar extracts soon soils or destroys gauge glasses, but the character of the glass float entitles it to be called clear, blue, and everlasting. When the old time cork floats have been replaced with these bright blue or red bulbs much time and anxiety are saved to the gas makers, whose eyes cannot quickly discern the ever changing water level In water gas manufacture they are especially useful, as pressures can be read almost instantaneously.

WRINKLE DEPARTMENT
PLATE VI.

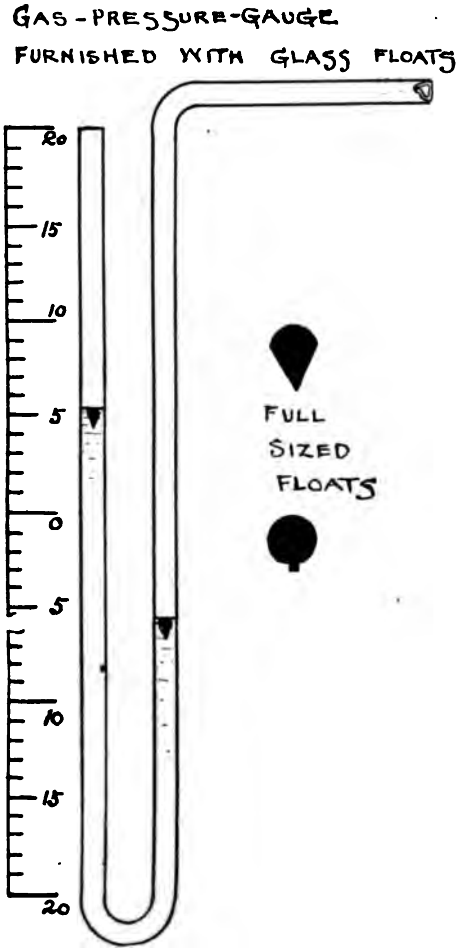


APPARATUS FOR TAKING GAS TEMPERATURE AT CONSUMER'S METER

The device of a colored glass float to indicate the water level in a steam boiler originated, in so far as I know, with Mr. E. W. Spear. of Boston. I do not know who first applied the float to gas pressure gauges. but it is easy to see its usefulness, especially where the gauge glasses are soiled by the deposition of tar or dust, or where the water level is obscured through lack of light, or by reason of distance. I learn that an effort either has been made or is being made to cover by patent the general use of the glass float, but no patent has yet been issued.

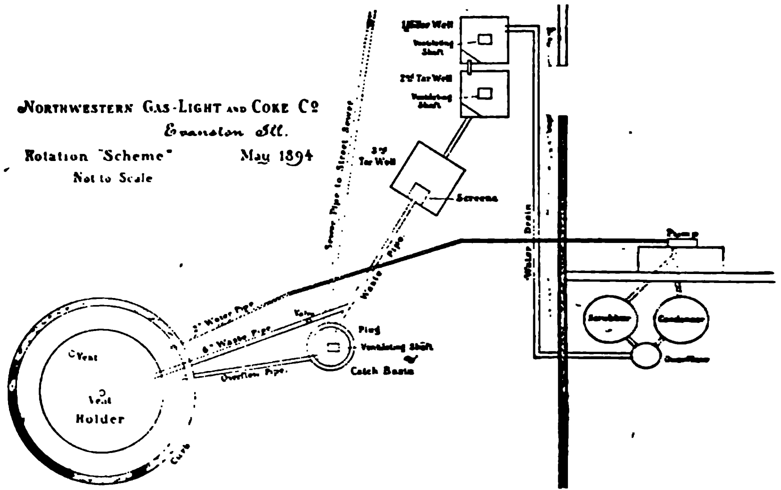
W. E. McKay.

Notes on the Disposal of the Wash-Water from Water Gas Plants.—XVIII. We have had the same trouble which all gas works experience that have no flowing stream nor even a swamp in which to dump their refuse. When the first water gas plant was installed in Evanston, in 1888, all the wash-waters, accompanied by tar, wash oil or naphtha, condensation, etc., were allowed to run freely into one of the common sewers of the town, and thence to Lake Michigan. It was not long before complaints of the odor and the filling up of the sewer came pouring in. We then sunk two 6 ft. x 6 ft. basins, trapped top and bottom, connecting with two catch basins, to our private sewer, which ran into a large public sewer. As a result of this and some minor improvements, together with care in not allowing the basins to fill up with tar, and in frequent skimming off of the oily matters on top of the water in the basins, all tarry residues were kept entirely out of the public sewers. But this did not suffice. Complaints about the odor still came. So we put in another large basin, placed ventilating shafts in all these reservoirs, and connected a fan so that it drew its air from the public sewer ***against*** the running stream in our private sewer. These devices appeared to help the matter somewhat, but just at this time (October, 1893) our water rate, which had been a special one of $100 per annum, was cancelled, meters located in the works, and the



A Gas Gauge Float.

rate placed at 10 cents per 1,000 gallons. We used the water for condensing, cooling and washing just as freely, and our water bill immediately jumped to $80 a month. This alarmed us, so we stinted the supply, and then the music began. Complaints of property being ruined, unfit for sale or residence, came so frequently that the city authorities took hold once more. Many plans for the elimination of the odor from the water were suggested at a joint meeting of the City Council Sewer Committee, Commissioner of Public Works, Board of Health, and ourselves. These plans were to try precipitation, deodorization, volatilization and filtration. None of these possessed even a fraction of feasibility, save possibly the latter, which we intended to try if our present practice proved a failure. We finally evolved a scheme of prevention rather than cure, which we call "Rotation," for lack of a better term.



Illustrating Wrinkle XVIII

Having built a new 150.000 feet holder, in 1893, for night consumption, and having our second holder of 60.000 feet for the day time, we had still the original 20.000 feet holder, which was not now used, and, being located conveniently near the works, was available for an experiment. We dropped the holder to the bottom of the pit, by-passed the last catch basin in the yard, and ran a 6-inch main through the masonry wall and shell of the holder, thus permitting the waste waters to flow into the holder: any odors can pass through ventilating pipes. Next we connected a 2-inch suction pipe from near the bottom of the outside of the pit to the pump, and thence to the condenser and scrubber as usual. By this plan as outlined we use the water over and over again, hence the term "rotation." We have been operating as described only one month, but the plan is a success thus far, and we can see no reason for a failure in the future. The pit being forty feet in diameter, and having ten feet of water up to the overflow, will hold about 100,000 gallons, which being deep in the ground is bound to be cool summer and winter. The suction pipe is six feet below the surface of the water. We find the condenser is kept cold with a slow but continuous motion of the pump, and our water bill promises to be below $5 per month. We still have use of the sewer to flush the holder, which may be once or twice a year, but otherwise no wash waters leave the works, consequently our burden of complaints, in one direction at least, has been dropped. The plan is very simple, but eminently satisfactory. A rough sketch, not drawn to scale, to illustrate our method accompanies this paper.

W. Lee Brown.

THE QUESTION BOX.

The President—That concludes our list of papers, and we will take up the few questions remaining. The first is:

"*Is there a market for retort carbons, and what price does this carbon bring?*"

Mr. Butterworth—Virtually the same question was asked at the Ohio meeting, and was followed by a very painful silence. There was no one to answer.

Mr. Keller—I just came from the Standard Carbon Company's works. I have, I suppose, five or six tons to sell. I asked them what they would give for it. They said they could allow scarcely anything, owing to the distance I was away. I asked them what they would give for it delivered. They said they would allow me about $10 per ton f. o. b. in Cleveland.

The President—We will take up the "Wrinkle Department" again before asking the other two questions. This department has been very carefully prepared, and it contains a number of valuable ideas. If anyone desires to ask any questions about any of the suggestions, or if there is to be any discussion, we will have it now.

Mr. Thompson—There is one feature about this Wrinkle Department which might entitle it to the name of "Columbian" Department, for it contains contributions from Columbus, Ohio, Columbus, Georgia, and Columbus, Indiana.

Mr. Butterworth—There is one Wrinkle which you can see between the lines of one of Mr. Thompson's descriptions, and which I think is rather a valuable one. If a consumer asks me hereafter whether I introduce any air into my gas, I will say, "No; but I do take in a little nitrogenated oxygen."

Mr. Ferrier—I would ask Mr. Dunbar if the regulation of the amount of air passing is done wholly by hand?

Mr. Dunbar—Yes.

Mr. Ferrier—Do you know any automatic arrangement which will allow of the admission of air according to the station meter?

Mr. Dunbar—No.

Mr. Thompson—There are several such arrangements proposed. The only one I have ever seen operating was one in which one of the dials of the station meter had its shaft extended with a chain gearing to connect with a small wet meter which was used as a pump. That was at the Ramsgate works, in England, and was used in connection with Valon's oxygen process, in which connection it was especially necessary. It has been proposed, in addition to that, to use the exhauster instead of the station meter as a means of proportioning the flow of air. In our own case we use a dry meter as described. and run the exhauster at a constant vacuum. We change the inlet of the meter (the opening on the valve) only when we alter the rate of make of gas. I might add that the meter readings are taken every hour, so that there is no possibility of any lengthy period passing without the ratio of air to make being very carefully regulated.

Mr. Ferrier—It would not be suitable for smaller gas works?

Mr. Thompson—Hardly. In the case of small gas works I think that readings every twelve hours could be taken without difficulty, and would probably prove sufficient.

The President—We will resume the questions:

"*Can any member give information in regard to the Peebles' process of making gas from coal tar?*" No response.

"*What would be the additional expense of enriching water gas from 20 to 25 candles?*" No response.

COMMITTEE OF ARRANGEMENTS FOR '95.

The President—I am requested by Mr. Baxter to announce the following Committee of Arrangements for the next meeting: John Young. Robert Young. John H. McElroy. F. L. Slocum, James H. Gardiner. Jr. I should take pleasure in introducing to you and turning over the gavel and interests of the Association to the incoming President. but it happens that he is not here. Is there any further business before the Association?

Mr. Butterworth—As Chairman of the Committee on Final Resolutions I have to present the following:

FINAL RESOLUTIONS.

Whereas. The 17th Annual Meeting of the Western Gas Association is about to adjourn after a most successful and profitable session: and, WHEREAS, We believe that public and formal acknowedgment should be made by us of our obligations to those who have contributed to this success; therefore,

Resolved, That we hereby express our appreciation and thanks for the efforts that have been so freely and efficiently given in behalf of the success of this meeting, and the pleasure of our members, by the Cleveland Gas Companies and by their officers, individually; by the exhibitors of gas apparatus, who have provided for us a most notable and interesting exhibition of their appliances; by the local manufacturing companies, who have co-operated with the Gas Companies in providing social entertainment for our enjoyment; by the Committee of Arrangements; by the Cleveland Press; and last, but not least, by the officers and of the Association, especially the President and retiring Secretary, the latter having closed with this meeting a long term of efficient service in behalf of the Association.

IRVIN BUTTERWORTH,
B. A. WARD,
W. H. ODIORNE,
Committee.

On motion of MR. GWYNN the report was received and adopted.

THE PRESIDENT—Before we separate I wish to say on behalf of the officers of this meeting that we thank you all for your kind attention and for your very efficient help in carrying the meeting through; and while this has been a rather lengthy session this morning, and continued under some difficulties, we feel that success has attended it to its close. Is there anything further before the Association?

AN INVITATION.

MR. HARBISON—Having been for quite a term of years engaged in the gas industry, and devoted perhaps as many hours a day to it as the average gas man does or ought to, to say the least, I have felt for years that the gas manager has not taken proper care of himself and of his clerks; that the office accommodations of gas companies generally throughout the country are not at all what they ought to be. I want to say that in our case, at Hartford, we have made a new departure. The reason, or one of the reasons, I was absent from your meeting a year ago was because we were just starting the erection of a new office building. It is now nearly completed. During the many years I have been privileged to come to your Western meetings I have been received in the most cordial and hospitable manner by every member of the Association—a reception which I warmly appreciated. I do not very often see members of the Western Association in the city of Hartford—much to my regret and greatly to their loss. (Laughter.) But there was not anything specially attractive even in the Manager of the gas works there, nor in the works themselves, and so I could not reasonably expect that they would inconvenience them selves to come. But now, sir, we will have an office that is worth journeying a thousand miles to see. Within the next thirty days we expect to dedicate what I think will be the finest gas office in the United States; and I would be very happy to welcome any and all the members of this Association to see that office. I will try to be there if you will let me know when you are coming, in order that I may have the pleasure of taking you by the hand. I think it will be worth a little effort on your part to see it. Our consumers always want the very best, and we have aimed to give them the very best.

THE PRESIDENT—We thank you for your kind invitation, and I am sure when any of us get anywhere near you we shall certainly accept it. This meeting now stands adjourned.

PROCEEDINGS

OF THE

WESTERN GAS ASSOCIATION

EIGHTEENTH ANNUAL MEETING,

HELD AT

PITTSBURGH, PA.,

May 15 and 16, 1895.

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Isaac C Baxter

PROCEEDINGS
— OF THE —
WESTERN GAS ASSOCIATION.

EIGHTEENTH ANNUAL MEETING,
— HELD AT —
MONONGAHELA HOUSE, PITTSBURGH, PA.,
May 15th and 16th, 1895.

FIRST DAY—MORNING SESSION.

The eighteenth annual meeting of the Western Gas Association, held at the Monongahela House, Pittsburgh, Pa., on May 15, 16 and 17. was called to order at 10:30 A.M., of the 15th, by the President, Mr. Isaac C. Baxter, of Detroit, Mich.

The President then introduced to the convention the Hon. Mr. McKenna, Mayor of Pittsburgh, who welcomed the Association and its guests in the following words:

ADDRESS OF WELCOME.

Mr. Chairman and Gentlemen of the Convention: I scarcely know what to say to a lot of gas men, for theirs is a commodity that I do not know much about. If it were wind, or a different kind of (say natural) gas, probably I could say something to you about it. Gas we have plenty of here in the city, but I have not been used to it. However, I wish, as the Chief Magistrate of the city, to extend a welcome to you all, especially to those who come from a distance, and to offer them the privileges and rights of Pittsburgh, and whatever they desire, in common with the residents of this town, while they are here. I would ask and advise those who come from a distance to visit our rolling mills and factories, and thus learn how the reputation for business as manufacturers has been obtained by the mill owners of Pittsburgh. In convention here I hope that all your deliberations will lead to the accomplishment of the purposes in view, and that when you adjourn it will be with a pleasant remembrance of the city of Pittsburgh. Wishing you all a pleasant time here, and again extending to you a welcome in the city, I will no longer interrupt the regular order of your proceedings. (Applause.)

THE ASSOCIATION'S RESPONSE.

The President—I will ask Mr. C. H. Evans of Chicago to respond.

Mr. Evans—Mr. Mayor, Mr. President and Gentlemen of the Western Gas Association: The hearty words of welcome which the Chief Magistrate of this city gave to you cannot help but convince each one of you that we are among our friends. When our Committee reported in favor of Pittsburgh as the next place of meeting there were quite a number of misgivings amongst us, many thinking that perhaps a more Western town would be preferable. But with such hospitality extended to us, who can now say that the choice of the Committee was not the wisest? If business or inclination should ever bring the Mayor of this city to any of our Western cities, I can assure him that the hand of fellowship will be extended; and should he desire to look around, just hunt up the local gas man, and he will be sure to see the town by day light or gas light, whichever the way may be. Just try us, Mr. Mayor: try us and see. I desire to extend to you, Mr. Mayor, the sincere thanks of this Association for your kindly words of welcome.

ROUTINE BUSINESS.

The President, having announced that, as the same had been published, the minutes of the last meeting would not be read, named the following gentlemen as a Committee on Invitation to Visitors, to act on behalf of the Association to welcome them: Messrs. W. H. Odiorne, John Young and E. G. Pratt. Mr. Odiorne, speaking for the Committee, said: If there are any visiting members here from other Associations we shall be glad to have them rise and be introduced to the members of the Western Association. [Several gentlemen rose.] Gentlemen, we are glad to see you here, and hope you will make yourselves at home: that you will have a pleasant time and be benefitted by this meeting.

Mr. W. R. Addicks voiced the sentiment of the visitors when he gracefully thanked the Association for the warmth of its welcome.

The President then read the following:

ADDRESS OF THE PRESIDENT.

Gentlemen of the Western Gas Association:

Introductory.—Another year with its trials and hardships, its sorrows and losses, its advancements and gains, its joys and pleasures, finds us again assembled upon a plane of fraternal equality; receding for a time from the individual, and considering only the common welfare of the great industry we represent; united in the purpose of comparing our theories, views and experiences, and prescribing each for the other's ills.

With feelings of mingled pleasure and regret this position of honor was accepted at your hands—pleasure at the assurance of trust reposed by you in me, and regret at my inability to perform its duties as others preceding me have done. Fully realizing how many of our number were more thoroughly qualified to occupy this chair, there has been occasion for many misgivings, causing much hesitancy upon my part; but the knowledge that your earnest, hearty co-operation would be mine, was sufficient inducement for me to consent to act to the best of my ability in this present position. With a feeling of pride this gavel has been accepted from the hand of my very worthy predecessor, for one cannot be otherwise than elevated by so hearty an expression of the good-will, esteem and appreciation of this Association, to whose influence during the struggles of former years I feel myself so deeply indebted.

Resources of Pittsburgh.—When we learned that our eighteenth annual meeting was to be held in Pittsburgh, the Greater Pittsburgh (as we may say), and the Sheffield of America, there was cause for congratulating ourselves upon the splendid opportunities thus presented; for here, through Nature's marvelous gifts, God speaks in unmistakable tones to His creature man, appealing to his necessities and sympathies, bidding him to utilize the talents with which He has endowed him.

Pittsburgh, the name is the synonym of advancement, of the vastness of natural resources, of mechanical skill and business ability. Here, where less than two centuries ago a few scattered people were struggling for a home against the wiles and treachery of the savage, a new country has advanced, until to-day, we see Pittsburgh marching on steadily towards the head of the long list of the world's greatest manufacturing cities. Her fame is not confined by the deep waters of the Atlantic and Pacific; for these surrounding mammoth steel and iron works, numerous blast furnaces, large glass manufactories, great coal fields, vast oil and natural gas territories, and splendid shipping facilities, speak out in praise of the indomitable pluck and perseverance of her people to the inhabitants of both hemispheres. Is it a wonder that men seem to expand and grow taller when they proclaim themselves "Pittsburghers?"

As a former resident of this city, I can assure you that her hospitable gates are open to you, and regret exceedingly that time will not permit those visiting Pittsburgh for the first time to see but a small portion of her glory. My first introduction to the gas business is always recalled to memory by the mention of this place, and my friendly feeling toward the city is one found amongst all men who have made their homes within her doors.

Our Honored Dead.—Since our last meeting the sad intelligence of the death of our worthy and faithful friends, Geo. H. Wells, of Nashville, Tenn., and Henry Felt, Jr., of Cincinnati, has come with a shock to the knowledge of our fraternity. Well known through his long identification with our industry, it is difficult to realize that the familiar face of Mr. Wells shall grace no more these meetings; that his kind, cheerful voice is stilled forever; and that the warm blood is cold and stagnant in the hand we so often clasped in the strong grasp of friendship and brotherhood. His ready assistance and reliable advice will be greatly missed by the younger men, who looked upon him as a great good friend. But his good works live after him, reflected by those whom he has befriended. It is not my intention to eulogize our departed associates, but we shall later on commit to some of their most intimate friends the task of preparing a suitable tribute to their memory.

Other Addresses.—So many entertaining and excellent addresses have been read before the various Gas Associations that it is almost an impossibility to select a new and interesting subject, but I hope that my treatment of several important topics pertaining to our interests may prove of some advantage to you.

Results of Past Year.—Considering the business depression prevalent throughout the country during the past year, and the sharp competition of electric lighting concerns, the increased consumption of gas, for both lighting and fuel purposes, argues well for the future prosperity of our business.

Incandescent Lighting.—In the competition existing between the two great lighting industries, the gas and electric, the Welsbach light, coming to our assistance, has caused a check upon the inroads formerly made into our business by our competitors. For some time this burner was looked upon in a doubtful manner, but is now a recognized success, a fact fully realized by electric light people in places where the new light has been pushed to the front. I can add little or nothing to the general knowledge of this invention and of its effect, as the past year has brought it so clearly to the view of all America that such information as I could give would be rendered both superfluous and unnecessary. It has so revolutionized modern lighting that the manufacturers meet with great difficulty in supplying the demand, and we find ourselves by its agency placed where we need have no fear of serious competition in cities where anything like reasonable gas rates are levied.

Prepayment Meter.—The question of introducing the prepayment or "penny-in-the-slot" meter has been agitated by the different gas companies for some time past. Like every new improvement, it is looked upon by many with suspicion and pronounced unreliable; but I can assure you this meter is not such a new thing. The large number of English companies by whom it has been used for several years, and their commendation of its work, is sufficient evidence of its assured success. Meters of this kind are on exhibition at the display of gas appliances, and the gentlemen in charge will take great pleasure in explaining their operation and advantages. It can be readily seen that they are so constructed as to render practically impossible any inaccuracy in the registration of the amount of gas delivered for each coin, and should counterfeit coins be dropped into the slot, they would fall into a box, to which the gas inspector alone has possession of the key, and. upon examination, such deception could readily be detected.

After the experience so many of us have had with the deposit system, we at length perceive a substitute which would put an end to much dissatisfaction. Our demand for a deposit, before meter and connections are placed at the disposal of a new consumer, constantly encounters his disapproval, for the reason that he is not always prepared to meet our demand without inconvenience to himself. With the prepayment meter he may buy from the gas company as he buys from the cash grocer, paying for his light as he desires to make use of it. There is no doubt that a great many have been deterred from the use of gas by misrepresentations in regard to the amounts of monthly gas bills. In case of the application of this meter there would follow a speedy reaction, and the payments being made in very small instalments would soon dispel the illusions which have become impressed upon the minds of the general public. This is not a theory, but has been proven an axiom by the experience of companies that have taken the initiative in this matter.

Gas Stoves.—Much satisfaction should be derived from the knowledge that the manufacturers of gas stoves are adopting the plan of establishing reliable and responsible agencies in most of the large cities and towns, especially where gas companies request them to do so, and where the trade has been allowed to take care of itself to an exasperating degree.

In many instances the duties of a superintendent and his associates are such that they have a choice of two things—first, to neglect the gas stove trade, or second, to neglect something probably more important. To such persons the placing of this business in the hands of some energetic and straightforward business man is the proper thing to do. The agent always has time to explain to a prospective purchaser, and can be depended upon, if assisted occasionally, to do the business justice.

The gas stove has long since advanced beyond the experimental stage, but people have been very tardy in recognizing the fact. The result of inquiries. made at the home of a friend where a gas range or heater is seen in use, is that the inquirer ceases to be a doubting Thomas, and in a short time has followed his friend's example and purchases "Comfort."

Its progress has been steady and satisfactory. In recent years we have seen the institution of several extensive manufactories, and in one case at least we find one of the largest coal range establishments

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in the world turn to the production of gas cooking and heating appliances. From my own observation of their work in that respect, and the information I have gleaned, they have met with no disappointment in their expectations, and others may be expected to fall into line.

Gas Engines.—The gas engine, by means of which we at one time thought our consumption would materially increase, has not advanced as we had hoped. A frequent comment upon this subject is that, when the manufacturers ask a price, the mere mention of which does not stagger an inquirer and cause his hair to stand on end, then this motive power will be more generally adopted. The advancement of the gas engine has not been retarded by negligence on the part of our fellow superintendents; but I am sorry to say the error lies entirely to the discredit of others. We cannot accomplish much on this line until a fair article at a just price is produced.

One reason advanced for the excessive prices of gas motors has been their extraordinary weight and complicated construction. Does it not seem probable that there should be more rapid perfection of these engines, and that they could be constructed to meet the exigencies of the times? They have cheap electric motors and reliable steam appliances with which to contend, and I am of the opinion that a mode of producing power with a cheaper first cost and less operating expense with gas can be developed than any that has to the present time been introduced to our notice. Serious objections to former apparatus have been diminished or entirely removed, and there is nothing within the bounds of reason that man's ingenuity cannot be relied upon to accomplish, if exerted upon the proper plane. Although some have gone to considerable trouble to show that electric and water motors are more desirable than those employing gas as an agency, we are forced to grant them no advantage except that embodied in the primary cost. With gas at a fair rate we can show a minor cost of operation and less wear and tear than either.

As a demand exists for the displacement of steam appliances, where not more than 10-horse power is required, gas engineers are inclined to assist in the introduction of a motor most favorable to their own interests; but they must have the co-operation of the manufacturers. It remains to be seen to what extent this co-operation shall in the near future extend: but it is to be hoped considerable more shall be accomplished during the succeeding year than the harvest of the past has shown. It behooves gas companies to give space to these motors themselves whenever it can be done. In our large plants are situated isolated buildings in which a limited power is required for various purposes, and here we can use such engines to advantage. By ascertaining their results through personal contact with them, our recommendations to consumers will seem more plausible.

Street Car Propulsion.—Information in regard to street car propulsion bids fair to cause a revolution in our city railway systems. The matter of the practicability and economy of cars propelled by the gas motor as an agency of power has been investigated thoroughly and has been clearly demonstrated by strict and reliable tests.

What are the advantages of the adoption of the gas motors in street railway service? A very obvious one is that the stringing of a network of dangerous electric wires would not be required. It would also put an end to one of our most deadly enemies—electrolysis—and to a source of dangerous interference with telegraph and telephone wires. We are able to say to its credit that each car would be independent of any central power station, and, in case it should meet with an accident, would not become an obstruction to the progress of others, as it could be readily attached to another car and removed to the repair shop. It seems to me (viewing the experience of myself and others with whom I have conversed upon the subject) that accidents at electric power stations have generally occurred at a time when service is most in demand. We have been informed of the great expense of construction of the cable, the noise and danger of the trolley, and of the high operating cost and unreliability of the electric systems.

In reference to the gas motors we may notice some experiences. The following results of practical tests made at Dresden are cited among these:

Cost of construction for a 5-mile, double-track road, 20 cars, all wires, horses, motors and other equipments included:

By gas motor system, cost.............$28,500 per mile.
" electrical " " .... 36,200 "
" horse car " " .... 26,700 "

The net operating expenses follow:

By gas motor system................. 6.0 cts. per mile.
" electrical " .... 8.0 " "
" horse car " ....10.0 " "

And show an economy of 25 per cent. in favor of gas against electricity as an agent of power, and an average of 40 per cent. against the adoption of the horse car.

Although these motors have been in use a comparatively short time, they have already made wonderful advancement. They are receiving the attention of the ablest mechanical minds in the world, and among the many improvements have been the reduction of weight and an increase in the maximum speed from 6½ to 15 miles per hour. They easily ascend a grade of 1 in 20, and have rounded curves with the short radius of 38 feet. Results upon transit lines operating them have been so satisfactory that horse cars are being rapidly displaced, extensions to existing railways made, and new lines constructed. So much having been accomplished before this method has received an introduction to Yankee ingenuity, we can expect some remarkable results should enterprising American manufacturers see fit to commence their construction. A model is expected very soon, and then our people will be brought to a realization of what it truly is. This is a matter in which it is to be hoped the representatives of this, the fifth ranking industry of this nation, with its capital investment of over $258,000,000, will take the deepest interest.

During the first year of operation, at Dessau, Germany, the consumption of gas has averaged about 500,000 cubic feet per car. By ascertaining the number of cars in operation in your respective cities you can easily calculate the amount of revenue your companies may expect each year upon the general adoption of this system. These facts, clearly demonstrating that the mind of the inventor, in searching for the most available power, is again ready to consider the entire field and not confine himself to electricity alone, are of vast importance to us, and should lead to the accomplishment of something in our country. Should the gas motor be adopted in the street railway service an enormous increase in consumption would ensue, as such an event would be accompanied by a decreased rate to consumers, both for fuel and lighting purposes, and would enable us to extend our business among those whom we cannot now reach. One advantage can always be relied upon to clear the pathway for others.

Marine Engines.—Attention has been recently directed to the application of the gas motor in another direction—namely, as an agent of power for marine navigation. A few months ago there was completed a 400-ton propeller, equipped with a 40-horse power gas engine and compressing tanks with a capacity sufficient for a voyage of 400 miles. The engineer, to whose energy and talent this experiment is due, is entitled to our sincere plaudits, and, as business men, we feel deeply interested in the ultimate success of his enterprise, as such a result will mark another important epoch in the advancement of our industry. The logical conclusion is, that if such vessels can be constructed for comparatively short journeys, they can assuredly be made suitable for traveling greater distances. We may, therefore, soon observe the dawn of a day when the gas engine shall be employed as an important agent in the world's great commercial transfer lines. The idea is certainly a feasible one, and while we cannot reasonably expect to see instant perfection in the method, we may be confident that the final results acquired by the thorough application of competent engineers will prove satisfactory to our interests.

Oil-Water Processes.—This may be called an era of oil-water gas processes. Companies throughout the country are being tormented to-day by circulars putting forth in their best light the claims of numerous methods, some of which are the inventions of deluded persons whose infinitesimal minds have been subjected to too great an application to matters with which they are really unacquainted.

When a man with some scattered (half theoretical and half mechanical) ideas has nothing particular to do, he immediately gives himself up to the pursuit of invention; and in the majority of cases when he does so, some other person eventually finds himself under the burden. In many of these pamphlets the well-informed can readily detect the presence of considerable assumption of impossible results, and presumption upon the ignorance of people to whom they hold out a baited hook. We receive inquiries in regard to a certain apparatus recommended to some company, and in reply are forced to admit we know little or nothing concerning it, as an investigation generally brings out the fact that the process mentioned is used merely in one or two isolated villages; and in one of these we invariably discover the patentee. If things continue as they have recently begun, the water gas people who are putting out first-class machinery, and whose results are as good as their word, must take some steps to protect themselves. Some companies have been greatly imposed upon; a few have realized this, while others have not.

A few oil-water plants, erected upon very flattering promises of ambitious and bombastic inventors, have, upon practical tests, been found to be far less economical than represented, while others have exceeded the claims of patentees and constructors. To many inland companies, situated conveniently near the oil fields and refineries, there is no doubt oil-water plants are most desirable, as railroad freights in some instances are very exorbitant and increase the price of coal to a great extent. Persons possessing no practical knowledge of these different methods, but expecting in the near future to erect oil-water gas apparatus, would find it advisable to obtain from experienced engineers statements of results obtained from different processes, thus enabling themselves to select that apparatus giving the most beneficial results.

We note with pleasure the steady growth of this branch of our industry in foreign countries. Advertisements requesting additions to the number of constructing engineers already sent over from America are found inserted in many editions of our various scientific journals, and we should desire to satisfy these people that our great nation is not deceiving them; that when we say we have a good article for the world at large, we have it and give it for what it is worth. Justice demands that we should prevent any imposition upon our neighbors, and that they should be advised against the frauds developed in the past several years. The Golden Rule is one not universally practiced in business, but we have the first time to learn where it has injured either party when strictly adhered to. When your neighbor asks for bread do not give him a stone.

Residuals.—Much has been said at former meetings in regard to the sale of residuals obtained by the distillation of coal—namely, coke, coal tar and ammonia. Presuming that all coal gas companies here represented are making ready and profitable sales of the first two bye-products named, I cannot refrain from calling your attention for a short time to the third. Should the inquiry be made of all companies carbonizing 5,000 or more tons of coal per annum, whether or not they were utilizing their ammoniacal liquor, I am quite positive many negative answers would be received in response. By some too little importance has been attached to this product, so indispensable to the human family, and so profitable to companies which have seen fit to concentrate their weak liquor, or to manufacture ammoniacal salt. For instance, a plant carbonizing 5,000 tons of coal per annum could produce 40 tons of concentrated ammoniacal liquor of 80 ounce strength, equivalent in bulk to 8,000 gallons. The product of one year could thus be consigned to the purchaser in two or three tank cars, and, in a plant of the capacity mentioned, would require the services of but one intelligent laborer for about 3 hours per day during each of, say, about 60 days, allowing sufficient time on these days to accomplish other labor about your works. The cost of operation is merely nominal, as it would not create the necessity of adding even one extra man to your old force.

As the different ammoniacal products and their uses may have escaped the observation of some of our members, I concluded to mention a few of them: Aqua ammonia, regarded by many as an indispensable household article; carbonate of ammonia, which finds its way into many of the most common articles of food; ammonium sulphate, most extensively employed as a fertilizer; ammonium chloride, the well known sal-ammoniac; a crystallized muriate of ammonia, used to a great extent in electric batteries; anhydrous ammonia, the great demand for which is being rapidly increased by the addition of many ice manufactories in our southern cities, and others having various uses. The concentrated liquor and refined ammonia are used in the manufacture of the above named compounds and also in the process of making soda ash.

At this time of sharp competition, with reduced gas rates and decreased revenues from our coke and tar, both of which products (especially the latter) have diminished considerably in value during the past few years, but which I am glad to say have recently shown a substantial increase, your ammoniacal product has thus become a very important item, and it is not so difficult to dispose of, as it is a product for which there is a demand for all seasons of the year. It is a cause of grievance to me to know that so much of it is allowed to be completely wasted. The machinery employed in concentration has been so cheapened and simplified by the improvements of late years that a very small lapse of time would enable you to pay the first cost of erection; and, in fact, considering opportunities some companies have wantonly rejected, I am sure some inducements already made by manufacturers to others would be very surprising to those of you who are not acquainted with this matter.

Fuel Gas.—The question of gaseous fuel is one of deep moment, not to us alone, but to the general public, whose great demand for such fuel is being daily heard. Here, then, arises a question which deserves our prompt attention. How are we going to satisfy this demand? In cities where natural gas cannot be obtained, and in natural gas districts where the supply is becoming inadequate to the demand, there must be something done toward relief from the use of solid fuel. It remains to us, as gas engineers, to solve this great and important problem, and to determine what is the best and cheapest method of manufacturing a fuel gas of the highest possible calorific power. Some say it has been done, but pause and ask yourselves again, "Has it been done in the proper manner?" A partial solution of the problems arising will be of no benefit; we must determine exactly how to meet all requirements in respect to economy, heating properties and the variability of the demand.

In this city and Allegheny the consumption of natural gas is much greater than that of any other cities of our country, both for domestic and manufacturing purposes. As gas wells are being abandoned, new ones are being opened to supply their enormous demand. What are these cities going to do when they can find no new wells to yield their wants? There is every evidence that the total exhaustion of this immediate territory is fast approaching, but I know of no section of the country better adapted to supply an artificial substitute; none with greater facilities at hand.

In the Connellsville region, about 50 miles from this city, the beehive coke ovens convert millions of tons of coal into salable coke each year, and within a radius of the same number of miles about Pittsburgh, over 65 per cent. of the American coke is produced annually from the best gas producing coals in America, namely the Youghiogheny, and the first, second and third pool coals. A large amount of gas and all the valuable coal tar and ammonia belching out at the top of the ovens are totally wasted. Such extravagant waste of the most valuable products of the carbonization of coal is due to a large extent to the use of an antiquated coke oven, the existence and operation of which greatly disappointed the English Society of Iron and Steel Engineers who visited this section about three years ago. This Society concluded (and justly too) that we were far behind our trans-Atlantic brethren in this matter, they having wisely taken measures to use all obtainable products.

Before the extraction of tar and ammoniacal liquor became a recognized accessory to the manufacture of coke, there existed a belief that only an inferior quality of coke similar to that obtained in our gas plants, and unfit for metallurgical purposes, could be obtained from any other than the beehive oven. The improved ovens of Apoldt, Semet, Coppee and others, have been for over 30 years in general use in Germany, Belgium and France, and their results have dispelled this illusion in England during the past decade. There the supposed infallibility of the old beehive oven has been obliterated, and such apparatus is being rapidly displaced by the methods of a later and more progressive date.

The process of extracting tar and ammonia by distillation in the manufacture of coke originated in France, remaining stationary for some time; but since the year 1881, when Germany began to take an interest in the matter, its advancement has been vigorous and rapid. The first furnaces adapted to the utilization of all products were due to the genius of Monsieur Knab, of St. Denis, near Paris, in the year 1856; but the method of preserving the tar and ammoniacal product was introduced by Hauport and Carves, the latter gentleman also effecting some improvement in the arrangement of furnace flues. In the apparatus the gases generated were passed into an hydraulic main, the tar and ammonia extracted, and the remaining gas drawn off by an exhauster and forced into the furnaces, thus being utilized as an agent of heat.

I shall not attempt a description of the numerous coke ovens patented during recent years, but shall give some notice to a few such inventions as are intended to utilize the gaseous products for heating purposes. It has been clearly demonstrated by experience that tarry products, similar to ordinary coal tar, and containing quantities of benzol, naphthaline, anthracine, and other hydrocarbons employed in the manufacture of drugs and aniline dyes, cannot be produced by ovens of the open kind admitting air. Attention is called to the excellent results and assured success of the Simon-Carves, the Ruperts, the Otto Hoffman and the Semet-Solvay ovens—the latter system being in use in the Solvay works, at Syracuse, N. Y.

The following is an abridged description of the Simon-Carves arrangement: It consists of a large oven, similar to a huge gas retort placed over the furnace, to an opening at the top of which coal is conveyed in cars, having a drop door at the bottom; the coal is thus simply dropped into the retort, and after it has been carbonized the resultant coke is pushed out by means of a steam ram. The gas is drawn away by an exhauster, and passes through the ordinary coal gas process, being subjected to condensing and scrubbing apparatus. The gas after this process is brought back by pipes and is burned under the combustion chambers of the furnaces and boilers. It may interest some to know that, in 1860, at the La Villette Works, the Paris Gas Company had in operation ovens for the production of metallurgical coke. The gas produced, being of an inferior quality, was mixed with a richer product made in ordinary retorts, and thus was utilized.

At no time since the introduction of gaseous fuel has the subject of an artificial substitute for natural gas attracted so much comment and produced so many able discussions as within the past few years. Although our journals have devoted a great quantity of space to our business colleagues upon this matter, there have been many points raised which cannot be said at present to be definitely settled. Why should the supply demanded by the residents of Pittsburgh and the neighboring cities not come from the adjoining coke-producing districts? By abandoning the present extravagant ovens, substituting furnaces and retorts similar to the Simon-Carves arrangement, erecting necessary condensing, scrubbing, purifying and storing apparatus, and laying adequate mains, this could without doubt be easily accomplished, and fuel gas furnished at a reasonable price. The contemplated failure of natural gas should not under existing circumstances be viewed with alarm by these cities.

The greatest obstacle to the adoption of fuel gas made entirely from coal is the necessary construction of immense gasholders required to distribute the product most economically. Storage capacity exceeding the maximum daily output is, if not exactly essential, at least desirable to any producing plant, as it provides for accidents which may require a discontinuation of operations for a period of several hours. Experience with coal gas has impressed upon engineers the great expense of intermittent work; and failure of supply inevitably delivers a blow to gas companies from the effects of which a considerable time is required for recovery.

I deem it advisable to call your attention to some experiences of our own Company with natural gas. We have found that the maximum demand exists for about six consecutive weeks in the year, and during several weeks prior to and succeeding that time we have experienced very cold weather, creating for a short time only about the same daily demand. The rate of consumption has upon several occasions increased 140 per cent. within a very few hours, owing to sudden decrease in temperature. An increase of from 100,000 to 240,000 cubic feet per hour in the rate of consumption is of frequent occurrence. and thus, in fourteen hours, were we supplying a manufactured fuel gas, we would be compelled to meet the difficulty arising from a sudden demand for an increase of 1,960,000 cubic feet in that time. The output during the remaining ten hours being meager in comparison, no material addition is required to these figures. We should be compelled. if operating any of the fuel gas apparatus now in use at other cities. to keep a certain amount of skilled labor, during a major portion of the time having absolutely nothing with which to keep it employed, and a wasteful consumption of fuel would be necessary to keep the plant ready for the requirements of a decreased temperature.

Now we are asked what plan is proposed to avoid this in the plant aforementioned. Simply this: A number of ovens could be kept in reserve for repairs, and those required for the maximum output could be kept in operation during that season when the greatest production is essential. When the total amount made is not required by consumers, by a simple valve arrangement the surplus gas could be utilized as fuel under the ovens, and by the heat generated in its combustion the carbonization of coal and manufacture of gas could be continued. Should the rate of consumption suddenly increase, solid fuel could again be brought to the rescue. The number of ovens in use could be regulated to suit the demands of the various seasons.

The quality of gas generated would be that of straight coal gas of 12 candles; and if this method were adopted by gas companies the product could be utilized also for illuminating purposes by being mixed with a richer gas in the gasometer. Where coal can be obtained at a reasonable rate, the method proposed could be adopted with advantage.

According to the United States geological survey for the year 1893, there were consumed in the manufacture of coke, in this immediate district, 9,336,702 tons of coal, from which were produced 6,229,051 tons of coke. The average results obtained from slack coal per ton of 2,000 pounds, carbonized in retorts, are as follows: 9,000 cubic feet of 13-candle gas; 1,260 pounds of coke; 11 gallons of tar, and 16 pounds of 80-ounce ammoniacal liquor. Therefore, the amount of coal aforementioned would yield 84,480,318,000 cubic feet of 13-candle gas; 11,887,244,520 pounds of coke; 103,253,722 gallons of tar, and 150,187,232 pounds of 80-ounce ammoniacal liquor.

Your attention having been previously called to the fact that coke alone of all these products is utilized, you can now perceive the enormity of the waste resulting from the use of these antiquated ovens.

From approximate data at hand it is found that 989 artificial gas companies operating in the United States produced, during the year 1894, 52,642,000,000 cubic feet of gas; and it is no doubt somewhat surprising to this fraternity to consider that this amount is over 37 per cent. less than that annually allowed to ascend from the craters of these Western Pennsylvania ovens. Granting that at least 60 per cent. of the gas made by these 989 companies is oil-water gas, then the deficit, considering coal alone, is over 75 per cent. In other words, while the companies of our vast territory producing coal gas are carbonizing 250 tons of coal, the gaseous products of over 1,000 tons are being lost in a very small comparative section. The realization of this fact more firmly fixes in our minds the propriety of the old adage, "Truth is sometimes stranger than fiction."

Having considered a change in the coking systems by which all products could be saved and utilized, and the disposition to be made of the gas manufactured, we are now confronted by questions in regard to the sale of the remaining products—namely, coal tar and ammonia. The answer to these questions may be condensed by the observation of two well-known facts: 1st, the constant displacement of coal gas by the greatly increased manufacture of oil-water gas; and, 2d, the steady growth of the industries of our nation, creating a greater demand for these by-products. In addition to the importation of large quantities of pitch and refined materials obtainable from coal tar each succeeding year, about one-half our total consumption of ammoniacal compounds is purchased from foreign countries. With the knowledge at hand that our gas works furnish but a small proportion of the American products, there seems no reason at present why the coke companies should meet with any considerable difficulty in obtaining a ready and profitable market for these residuals. These imports are not occasioned by excessive American prices, but by a deficit we cannot at present supply. In the treatment of this subject I regret that time does not permit me to say all I would; but if something has been offered toward the solution of an interesting and complicated problem, I shall feel that my effort has accomplished a desirable end.

Calcium Carbide.—"Calcium carbide" and "acetylene" are names which have met the view of the gas world as spectres of the night. As we have been promised a very interesting paper upon this subject, I shall pass it over with the expression of but few words. We have been so often threatened with complete and sudden annihilation by new discoveries that former circumstances would warrant the assertion that if this new gaseous product "acetylene" is to be an enemy, we can certainly find some means of sturdy warfare, and if it proves an auxiliary it shall meet with spontaneous welcome from our fraternity.

Municipal Control.—Proceeding to the question of municipal control of gas plants, a theme upon which there has been much thought and many debates, very little comment is necessary. Elaborate arguments have been made setting forth the marvellous success of many of the water works and electric lighting enterprises controlled by local governments, but I venture to state that, were the conditions of these institutions sifted to the bottom, there would be found a prevailing state of dishonesty and treachery to the public trust. And why? Because in order to maintain certain parties and people in power, the ward heeler must receive a reward for his patriotism in the form of an easy position which shall necessarily not interfere with his political work, and attached to which must be provided a reasonable salary paid from taxes collected from the public. Numerous instances of this kind could be cited by my fellows of this Association, as I presume that almost all of our members have at some time discovered some such condition of affairs.

We have the authorized statements of men of experience in municipal affairs to support these assertions, and the developments of investigations made clearly decide the existing fact that, under the present system, municipal control of public plants is, in a majority of cases, accompanied by more detriment than benefit to the majority of persons interested, and is, generally speaking, the outcome of a desire for revenge upon some unpopular corporation or persons.

Opportunities of our Young Men.—Opportunities offered our young men for advancement to-day are much greater than when many of us served our apprenticeship and during our earlier years in charge of plants. To-day the young man has an opportunity of improving himself by the study of chemistry, geometry, civil and mechanical engineering, and other sciences—aids to a gas engineer at all times. These are opportunities our young men should grasp, as they cannot afford to lay aside such an important matter as advancement in their chosen vocation. The practical man, with his knowledge of mechanics and routine work, and the theoretical man, whose knowledge is based upon a clear understanding of the sciences, are each desirable articles; but a man who is a combination of the two, certainly combines their value also. Do not plead lack of time, for no such thing exists. There is truth in the old assertion relating to a time and place for all things. Young men have been known to labor at the most menial callings by day, and during the evening hours devote time and attention to more important matters, by which in later years they were lifted far beyond the average.

It is to be sincerely hoped, as time progresses, the number of gas engineers with good executive ability, who can draw a company's plans, perform chemical experiments pertaining to its products, and be able to turn a hand, when necessary, to mechanical work, shall steadily increase; and if we are compelled by circumstances to employ others to accomplish such labors as these, it should surely give us the greatest satisfaction to know when they are performed in a correct manner. The advancement of the times demands that we should acquaint ourselves with the cause of problems commanding our attention, and the effect of their solution.

Conclusion.—Some words of appreciation are due the editors of the *American Gas Light Journal* and the *Progressive Age*, whose efficient services have contributed greatly towards the elevation of the gas industry, by their ready explanations of interesting problems, and other valuable information expressed through their columns. At no time since the publication of the first copy of an *American Gas Light Journal* have we been represented in such an able manner by a press devoted to our interests, and it is gratifying to know that our fraternities duly recognize their services.

My thanks are publicly expressed to Mr. Jos. D. Weeks, editor of the *American Manufacturer*, of this city, for the great assistance derived from his work on the "Manufacture of Coke," and to Mr. E. C. Brown, of New York, to whose valuable "Directory of American Gas Companies" I am indebted for aid in the compilation of statistics. This latter work is deserving of more encouragement from its real beneficiaries (the gas companies) in the future than it has hitherto received. Incomplete reports from many cities rendered it necessary to make approximate estimates in such cases, and there is no apparent reason why the editor should not obtain all desired information in a cheerful and prompt manner from the officials of the various companies. The work certainly deserves our patronage, and should receive it.

With an expression of my deep appreciation for the kind attention accorded, I shall conclude these remarks, hoping that, with the advantages at hand and discussions to follow upon papers of interest and intrinsic value to our future welfare, this meeting shall be made one long to be cherished in the hearts of our Association, to whose former gatherings we are now able to refer with sensations of genuine pride.

The address was referred for analysis to the following Committee: Messrs. E. H. Jenkins, Irvin Butterworth and E. G. Cowdery.

The Board of Directors submitted the following report:

REPORT OF BOARD OF DIRECTORS.

The annual meeting of the Board of Directors of the Western Gas Association was held at 11 A.M., Tuesday, May 14th, at the Monongahela House, Pittsburgh, Pa., and was called to order by the Presi-Mr. I. C. Baxter. The following members of the Board were present: Irvin Butterworth, Geo. T. Thompson, Wm. McDonald, James Forbes, W. M. Eaton, Robert Young, J. W. Stratton.

On motion of Mr. Thompson, the following papers were accepted for presentation to the Association:

"Incandescent Gas Lighting," by Mr. S. M. Highlands, Clinton, Ia.

"Metal Gasholder Tanks," by Mr. Alten S. Miller, Long Island City, N. Y.

"Advantage of the Metric System for All Calculations," by Mr. Geo. H. Harper, Altoona, Pa.

"Natural Gas as a Pioneer for Artificial Fuel Gas," by Mr. Donald McDonald, Louisville, Ky.

"Acetylene," by Mr. F. L. Slocum, Pittsburgh, Pa.

"Experience with Foul Gas," by Mr. Jas. T. Lynn, Detroit, Mich.

"Ammoniacal Liquor, with Special Reference to the Universal Saving of Same, by Gas Companies," by Mr. Geo. Osius, Detroit, Mich.

"Recuperative Furnaces, as Applied to Bench Firing; Their Operation and Results," by Mr. J. A. Faux, Pittsburgh, Pa.

"Best Method of Introducing Gas Engines," by Mr. C. B. Case, Milwaukee, Wis.

"The Storage and Handling of Oils in a Gas Works," by Mr. D. J. Collins, Chicago, Ill.

"Wrinkle Department," edited by Mr. Geo. T. Thompson, St. Louis, Mo.

On motion of Mr. Butterworth, it was carried that the hours of 9:30 A.M. and 1:30 P.M. be selected as the time for convening the meetings of the Association—Eastern time to govern.

The Secretary read his report of receipts and disbursements, as follows:

TREASURER'S REPORT.

Receipts.

To membership fees	$ 145 00	
" annual dues	1,033 00	
" sale of badges	45 50	
" balance from May 1, 1894	395 81	
		$1,619 31

Disbursements.

By Secretary's salary	$ 400 00	
" sundry bills, as per vouchers	887 73	
" bal. cash on hand, May 1, 1895	331 58	
		$1,619 31

The President appointed the following Committees:

AUDITING COMMITTEE—GEO. T. Thompson, W. M. Eaton and James Forbes.

APPLICATIONS ON MEMBERSHIP—Wm. McDonald, Irvin Butterworth, E. H. Jenkins.

On motion of Mr. Thompson, it was carried that the Association visit in a body the exhibition of gas appliances, after the adjournment of the first day's session.

On motion, the Board adjourned.

JAS. W. DUNBAR,
Secretary.

Mr. Thompson presented the following report:

REPORT OF THE AUDITING COMMITTEE.

To the Western Gas Association: Your Auditing Committee hereby report that they have examined the books of the Treasurer, and compared the past financial year with the amounts shown in the cash books; finding all correct and properly footed, with the reported balance in bank to the Association's credit.

Respectfully submitted,
GEO. T. THOMPSON,
W. M. EATON,
JAS. FORBES,
Auditing Committee.

LETTERS AND TELEGRAMS OF REGRET.

The Secretary announced that he had received letters or telegrams from the following named gentlemen, regretting their inability to acknowledge in person the Association's invitation to participate in the proceedings:

Col. J. H. Armington, Col. F. H. Benson, Mr. Fred. Egner, Mr. F. H. Eichbaum, Mr. J. Gimper, Mr. G. W. Graeff, Gen. Jno. P. Harbison, Mr. E. C. Jones, Mr. C. H. Nettleton, Mr. W. H. Pearson, Col. Jos. R. Thomas, Mr. A. C. Wood, Mr. W. A. Wood.

APPOINTMENT OF SPECIAL COMMITTEES.

The President then announced the membership of the following Special Committees:

ON NOMINATIONS—Messrs. J. B. Howard, Geo. G. Ramsdell, B. E. Chollar, Jas. Ferrier and A. F. Nash.

ON PLACE OF NEXT MEETING—Messrs. E. G. Cowdery, J. W. Stratton, Peter Young, W. M. Eaton and George E. Woods.

ON MEMORIALS—Messrs. Irvin Butterworth, Jas. Forbes and C. H. Evans.

ON FINAL RESOLUTIONS—Messrs. Jas. Somerville, J. A. Faux and W. B. Sellers.

READING THE PAPERS.

The President then introduced Mr. S. M. Highlands, of Clinton, Ia., who read the following paper on

INCANDESCENT GAS LIGHTING.

The subject of incandescent gas lighting, and its relation to the gas industry, is a question which would seem to warrant very careful consideration.

The Western Gas Association has been proverbial for its conservatism, but the individuals composing it have been as wide awake and progressive as those of any other industry of similar magnitude. Several years ago it was rank heresy to mention water gas at our meetings, but the officers of the various companies here represented investigated the merits of the new method of gas making, and the result is that nearly 90 per cent. of the gas made in the West is water gas, and they are again turning their attention to new methods which would seem to promise even better results.

With the advent of a properly constructed gas stove, they were quick to see its merits, and that its proper introduction meant not only largely increased sales of gas, but fortunes for the manufacturers, and to-day the gas company is the exception that does not carry a large line of stoves in a finely equipped show room, with men whose sole duty is to push their sale and use, as far as possible; and none of those who have earnestly tried the introduction of gas stoves have been disappointed.

The gas engine has not met with quite so cordial a reception. After a pretty thorough investigation of its merits, they have found its high cost, low consumption of gas and limited field would not permit of returns sufficiently remunerative to justify their handling them except as an incident, and to supply the wants of a customer who really wanted one.

With the advent of electric lighting came a new element of uncertainty, but a thorough investigation demonstrated two things: First, that there was actually a demand for electric light, and it was here to stay; second, that there was a fair margin of profit in the business, and the gas companies were the proper parties to handle it. To-day no less than 248 gas companies in the Central and Western States are operating electric light plants: and when such companies as the Laclede of St. Louis, the Cincinnati, the Louisville, St. Paul, Rochester and others engage in it as extensively as they have done, it demonstrates that the business actually has its merits; and so extensive has been the investment by Western gas companies in the electric light business, that this Association might, with propriety, be called the Western Gas and Electrical Association.

The foregoing are simply cited as illustrative of the fact that gas men are, as a rule, fully alive to their interests, and ever ready to take up and adopt any appliance or method that will add to their business and consequent profits, and equally able to discriminate against any appliance that would be either detrimental or not sufficiently profitable to warrant their taking up and adopting it either for their own use or the use of their customers.

With the advent of the incandescent gas lamp, we are met with two startling propositions. The first is the introduction of a gas burner which promises to give an efficiency of 300 to 400 per cent. as compared to those we have been accustomed to: the second is the introduction of a gas appliance through agencies entirely independent of the gas companies.

It is not necessary here to enter into a technical discussion of the Welsbach burner, as it is familiar to all of you, and it is to be presumed that most, if not all of you, have experimented enough with it to be pretty well satisfied in your own minds, both as to its merits and weaknesses.

We, as gas men, have labored long and earnestly to devise means whereby our sales of gas could be increased.

All our reductions in the prices of gas—and they have been many—have had this one object in view, and when these reductions have failed to increase the sales sufficiently to increase the gross revenue the reductions have been regarded as a business mistake. Our old coal gas benches and apparatus have been discarded and thrown into the scrap pile to make room for improved methods whereby we could make a better gas, and thereby increase our sales.

The history of the gas business up to the present time has been one of continued growth and prosperity, giving ample proof that we had successfully studied and managed the interests entrusted to our care. Now shall we, as custodians of these vast interests, adopt methods and appliances whose sole merit is that they will decrease our business and damage the interests which we are expected to protect? The sole recommendation of the incandescent gas lamp is that it will furnish a large volume of light with a small consumption of gas. No one ever pretended that the light is beautiful or pleasant, or the lamp ornamental. On the contrary, it is conceded by all that the color of the light is nothing but a ghastly glare, offensive and painful to the eye. No one ever thought that the rays from the electric arc were pleasing, or that it was fit for our houses, churches or clubs, and that it could but be barely tolerated in the large stores; yet it is a pleasing light as compared with the incandescent gas lamp with which we are most familiar. The only recommendation the incandescent electric light ever had was its convenience and the beauty and softness of the light, and while admittedly the most expensive light, it has merits enough to make it the most wonderful success this world has ever witnessed. Never before has any new appliance met with such a wide and extensive demand. The short space of fifteen years has been sufficient to thoroughly distribute it over the entire world, and the factories for making the lamps alone are numbered by the hundreds, with individual capacities of turning out many thousand lamps per day; and it is safe to assume that no less than half a million lamps per day are required to supply the demand for this most beautiful and expensive light. This in itself is sufficent proof that low price is not absolutely necessary to success. What else than low price of light has the incandescent gas lamp to recommend it? Possibly to use as a competitor of the electric light; but if so, to whose advantage? Certainly not to that of the gas company, if the old gas customers are also to be permitted to use it. Were this burner to be generally introduced at once to the present line of gas customers it would, without doubt, curtail our output for lighting purposes by at least 50 per cent., and the consequences of this wholesale reduction of the volume of our business you can picture to yourselves. As managers, how many of you would care to face the proposition? True, the burner has held a limited success in street lighting in some European cities, but its chances of displacing the electric arc lamp in American cities are so remote that it is not worth consideration.

If anything else were needed in this new and much advertised lamp to cause gas men to view it with alarm, it is found in the methods adopted for its introduction. In the majority of cities special agents are appointed for its sale who have no connection with the gas company, and any orders the gas company may give for lamps are entirely ignored.

The only possible interest these agents may have in the matter is to sell the greatest possible number of burners with the least exertion. His easiest and best customers are found amongst the largest gas customers—those whose bills are the greatest. Little if any effort is made by them to sell to users of electric light, and none at all to those who are using oil. Dwelling houses and stores that are not using gas are left severely alone, as not being worth bothering with.

So far as my investigation goes, those gas companies who have successfully met electric competition, and fattened under it, now find their consumption falling off because of the use of the incandescent gas lamp. Their number of consumers may be slightly increasing, but the increase in the number of consumers is more than offset by the reduction in the bills of their larger customers. The hardest thing in this connection the gas man has to contend with is that he cannot use this burner in working up business among the smaller houses, for the reasons: First, he cannot get the burners; and, second, they are too expensive for this class of customers to buy, and they are not able to give them the care necessary for their maintenance. Possibly some day we may be able to secure an incandescent gas lamp whose rays will be more pleasing, whose price will be reasonable, and which gas men can buy and sell along with their gas stoves and other appliances to whomsoever will buy. And when that day comes it may be to our interest to see them introduced: but today the electric light and carbon oil lamp are not half so dangerous to the gas man as is the incandescent gas lamp.

DISCUSSION.

MR. WALTON CLARK—I want to be the first to congratulate Mr. Highlands upon the courage he has shown in presenting this paper. He has shown not only that he has convictions, but that he has the full courage of his convictions, when he can stand up in the face of this display and say what he has said of the Welsbach light. While he has been reading I have made a few notes which, with your permission, I will read. Higher candle power means more light per cubic foot of gas. Whether this higher candle power results from richer gas, or from improvement in the conditions attending the combustion of the gas, the result is the same—an increase in the amount of light obtained by the consumer for every dollar paid over the desk of the cashier into the cash-drawer of the gas company, or a reduction in the number of dollars paid for the service previously enjoyed. It has been generally believed that this has resulted in good to the gas company. It is, I believe, considered an axiom by political economists that any improvement in the way of cheapening the cost of production results in the extension of sales, and increases the prosperity of the supplier. Certainly gas companies have had no reason to regret the displacement of old forms of burners by the checked batswing and the Argand, because with the improved service has come increased consumption of gas, and with the increased consumption has come increased prosperity. Why Mr. Highlands should anticipate a reversal of the laws of trade and the experience of gas companies in the case of the Welsbach light he has not made clear. In the absence of any demonstration of the discovery of new laws, we must believe that the old laws will prevail, and that the introduction of the Welsbach light will enable gas companies to hold their present desirable financial position. To be consistent, it seems to me that Mr. Highlands should oppose the introduction of gas stoves, or the use of any gas-saving appliances; he must refuse to supply new burners, or to aid his consumers in getting from the gas they burn the greatest possible amount of light. He knows, as his paper shows, that this course is not dictated by wisdom; and so, I think, we must look elsewhere to find the animus of his paper. Possibly it may be found in the following sentence: "If anything else were needed in this new and much advertised lamp to cause gas men to view it with alarm, it is found in the methods adopted for its introduction. In the majority of cities, special agents are appointed for its sale, who have no connection with the gas company, and any orders the gas company may give for lamps are entirely ignored." As to the truth of the statement that, "in the majority of cities special agents are appointed," I do not know. Doubtless if special agents are appointed, and the gas company is not intrusted with the sale of the lamps, it is because the experience of the Welsbach Company has been that it could not push its sales through the gas companies. I believe that Mr Highlands himself has previously put himself on record as having opposed the introduction of the Welsbach light because it burned too little gas, and that the Welsbach Company therefore did not give Mr. Highlands, in the city which he represents, the agency for the sale of the Welsbach light. As to that I think it probable some one connected with the Welsbach Company might have something to say. There was certainly a temporary reduction in the amount of gas sold in some of the European cities immediately following the introduction of the improved light; but that those reductions were permanent I do not at all believe. My experience in the companies with which I am associated shows that it is not permanent. On the contrary, it shows that the introduction of the Welsbach light increases the sales of gas. From the entirely inadequate compensation that comes to a "gas-house hustler," I have, in the course of 20 years, been able to save a few hundred dollars, which I have invested in gas stocks. I desire particularly that in the cities in which I am interested in gas property the Welsbach light should be pushed to the fullest extent. Mr. Highlands himself gives evidence that increase of sales must follow the introduction of Welsbach lights. He says, referring to the agents for the Welsbach light: "His easiest and best customers are found amongst the largest gas consumers. Those whose bills are the greatest." Now it is certain that the largest consumers are those who are to go to the use of the electric light. That certainly is the experience of the gas companies with which I am connected. He says again, referring to the small gas consumers: "They are too expensive for this class of customers to buy, and they are not able to give them the care necessary to their maintenance." Therefore, I think that, from Mr. Highlands' argument, we must draw the inevitable conclusion that the Welsbach light can be placed with gas consumers who are liable to use the electric light, and that it cannot be placed with gas consumers who are not liable to use the electric light. This would seem to indicate that the Welsbach light is an admirable instrument in the hands of a gas company to cut the electric light out of the field, without at all interfering with the consumption of the great majority of its consumers—the small consumers. Mr. Highlands says further, that "little, if any, effort is made by them to sell to users of electric light, and none at all to those who are using oil." He complains that the Welsbach Company does not go into the street and seek to extend the use of gas among the people who are living along the line of mains without introducing gas into their houses. But that is certainly not the business of the introducer of gas burners or appliances; it is the business of the local gas company, and if the superintendent of that company has properly looked after this matter there is no room for the Welsbach agent, or any other agent, to do anything more in that line.

Mr. Ramsdell—I should dislike very much to see this paper go on our records without the Association making a very earnest protest against it. I am entirely unfamiliar with Mr. Highlands' situation, and with the arrangements which he may or may not have with the Welsbach Company, which have been intimated upon this floor. But my experience with these lamps is so entirely different from his, as is the experience of about every gas man with whom I have had any conversation on the subject, that I am very confident we cannot afford to have such a statement go forth without an earnest protest. I do not propose to take his statements up *seriatim*; but, in the first place, I must say I think some of his propositions are entirely untenable, as based not only upon my own experience, but upon the experience of almost any of us. Taking our own experience as a basis (and I have no doubt it corresponds with that of most of the members), I may say that when we first began to use the Welsbach light I made pretty careful tests and records of its effect. The summary of those results shows that about one-third of the new consumption comes from oil consumers, about one-third from incandescent electric light consumers, and the balance from our own gas consumers; and I think I am safe in saying we have not a company where we have not increased our business – our sales of gas—by the introduction of the Welsbach light. Another thing worthy consideration is, I have found quite a strong desire for the Welsbach light for street lighting. I think the position taken on this point by Mr. Highlands is entirely wrong. We have closed three contracts for street lighting with Welsbach lights that I do not think we could have obtained in any other way. We have another contract pending, where the competition is from arc light, and there we have stationed lamps to show that three of these Welsbach lamps will afford as good illumination for all practical purposes as an arc light. We expect also to obtain that contract. I therefore think this Association should go upon record as protesting against the sentiments of that paper.

MR. HIGHLANDS—I do not believe that any gentlemen here present will accuse me of attempting to air a personal grievance. I have none. I think it well to hear both sides of the case, and will give an illustration. I will simply say this: You will probably remember that, in a paper I read a year ago before this Association, I said I had made the experiment of using Welsbach lights to drive out a municipal electric lighting plant in what was the adjoining town of Lyons, but which now constitutes the sixth and seventh wards of Clinton. The results of some of that work I have here. As some of you will probably remember, this is the place where we succeeded in driving the city electric light plant out by using the Welsbach light. In 1893 we had 135 meters set in this place, and were selling 2,407,500 cubic feet of gas, or an average of 17,830 feet per year per meter. In the year 1894 we were supplying all the stores with gas, nearly all of which are using incandescent gas lamps, and in the meantime a considerable number of private houses put in Welsbach lights on the fixtures where they would be used the most; so that here we have an ideal place to show the advantage of the introduction of the incandescent gas light. In 1894 we had 160 meters set in this district, through which was used 2,248,200 feet, an average loss per meter of 3,749, or a total loss of 599,840 feet; or, viewed in another light, we had driven out the electric light and increased our investment over $500, and lost the sale of 159,300 feet of gas in the experiment, and had increased the number of consumers by 25. I have one more statement as to the benefits derived from the introduction of the incandescent gas light. We have a club room in our city which used 81,400 feet of gas from January 1 to May 1, 1894. On January 1, 1895, we replaced the burners commonly used there with the Welsbach burners, and from that time to May 1, 1895, they used 35,400 feet—a loss to us of 46,000 feet, or over 50 per cent. on one customer in six months.

MR. HUMPHREYS—I do not care to say anything in answer to Mr. Highlands' paper in defence of the Welsbach light, because I think such action on my part would be unnecessary; but I would like to enter my protest against what seems to me to be the the spirit of the paper in a general way. Anything which we can do, no matter what the views we may hold about it at first may be, and no matter how frightened we may be as to the ultimate result—if there is anything that we can do to give our consumers more light for a given expenditure of money, it is our duty to do it. (Applause.) But I think we are entirely safe in going further than that, and that we can say in this case that "Honesty is the best policy." We have invariably found, so far, that where we have taken that course we have in the long run found profit from it. And I do not have the slightest hesitation in saying I believe that in the future, as in the past, we will find the introduction of this or of any other appliance which tends to give the consumer more light for a given expenditure of money will be to the advantage of the gas companies we represent. (Applause.)

MR. JENKINS—I fully agree with what has been said by those who preceded me, that this Association does not want to be put on record as opposing any device which may reduce the cost of our light to our consumers. We cannot afford to do that. We would have every newspaper in the country taking that question up and hammering us right and left. In fact they have said it against us enough times already. I want to say, however, there is one thing in Mr. Highlands' paper that meets my approval in this respect: I think the gas companies should, in every possible case, be the agent in introducing the Welsbach light. I know of a number of cases where special agents in towns have introduced them, with no interest whatever in the matter except to sell the burners. I can cite one city in the South where, in one season, 1,800 burners were sold, but in less than six months nearly one-half of those burners were out of use, simply because the agent had gone, and there was no one there to take care of the burners. That is a serious matter for our consideration. I was in a barber shop in another Southern city last week, in which there were three Welsbach lights and four ordinary gas burners, and I can assure you that one ordinary gas burner would have given as much light as did those three Welsbach lights, because of the condition in which they were. That is because an outside agent introduced those lights. We have pushed the Welsbach lights in Columbus, Ga., to the best of our ability, and without regard to who wanted them. We have sold a number of them there, and the percentage of sales has been about as follows: For displacement of gas burners, 52 per cent.; for displacement of electric lights, 35 per cent.; the remaining 13 per cent. is divided among consumers of oil and new consumers. We have increased our sales more than 12 per cent. over last year. (Applause.) I want to say another thing in the line of what Mr. Ramsdell said about street lighting. We made an experiment of about three months' duration with street lighting with the Welsbach, and I am satisfied, from that experiment, that in a town of ordinary size we can in a short time get back the best part of the street lighting, and at a figure that will pay us. (Applause.)

Mr. Howard—The experiences of Mr. Highlands and myself are entirely different with regard to the use of the Welsbach burner. I find that by the introduction of the Welsbach I have been able to knock out an electric light plant entirely. So I think it has been a good business. (Applause.) I find also that in respect to smaller consumers my experience differs from his. For instance, one of our butchers had two oil lamps in his store. I spoke to him about his seeming need of a better light, one which would prevent the odor of kerosene hanging round his beef after he had tended to his lamps. I also said that I would give him a burner which would yield him more light than did those two oil lamps, and at no greater cost. I made an agreement with him and put in a Welsbach light. His place is so small and his light so good that he has since said that if he could not get another he would not take $25 for that burner. In the Associations of Europe they have looked with favor upon the manufacturers of burners, and have given cognizance to the effect which is produced by recognizing merit. Mr. Sugg and Mr. Bray have been recognized by several Associations there with regard to their efforts in the perfection and introduction of improved gas burners. I think this Western Gas Association could do credit to itself by authorizing our Secretary to send a letter to Dr. Auer von Welsbach, stating that we honor him for the ingenuity and skill displayed in evolving a burner which is one of the best things given to the gas industry to avail itself of for many years. I offer that as a motion. (Seconded by Mr. Corscot.)

Mr. Butterworth—I would like to make a few remarks on Mr. Howard's motion. I wish simply to say it seems to me, in view of the fact that the Welsbach burner in its present improved form has been in use in this country for so short a time, that it is rather early to expect the returns to be coming in as to its effect upon the gas business; and especially so in view of the further fact that the makers have been unable to supply the demand. But we are nevertheless already receiving such returns as indicate how things are going. I have here a letter received from the Secretary of a gas company in a Western town of about 40,000 people, from which I will read a few lines—the letter itself was not written upon the subject of the Welsbach burner, but ends with the following reference to it: "The introduction of the Welsbach burner has worked a marvelous revolution in our business. Since its use our output has increased at least 50 per cent., mainly due to the Welsbach burner. The gas companies should raise a lasting monument to its inventor."

Mr. Harper—I live in a town in which, in the last few months, over 900 Welsbach lights have been placed, and to-day the output is greater than at any time in its previous history. The agency for the burner, for certain political reasons, is not held by the gas company; but he gets all possible encouragement from us, and the gas company does quite a large share of his advertising. One point which Mr. Highlands makes I wish to refer to. He says: "The chance of the Welsbach burner displacing the electric arc lamps in American cities is so remote that it is not worth consideration." In Altoona, Pa., this chance is worth consideration, because we have been able to displace 35 arc lights which were used for general store lighting; and in no individual case more than three arc lights were replaced in one store. This shows the unquestioned ability of the Welsbach light to take the place of arc lamps for general store lighting.

MR. RAMSDELL—I would like to add one thing which I omitted to state when I spoke before. Mr. Highlands says that "no one ever pretended that the light is beautiful or pleasant, or the lamp ornamental: on the contrary, it is conceded by all that the color of the light is nothing but a ghastly glare, offensive and painful to the eye." If I understand Mr. Highlands aright, when he prepared his paper he had not seen the Welsbach light as it is shown here in this hotel. Therefore, I would suggest that that part of his paper (if it can be done in accordance with our rules) be eliminated, if Mr. Highlands is willing.

MR. LYNN—I would like to detail some experience with regard to the introduction of the incandescent gas light in Detroit. To begin with, I will have to take issue with Mr. Jenkins with regard to the gas company handling this burner. In Detroit the burner is handled by the Gas Appliances Exchange, the Gas Company giving all the encouragement it can to the introduction of these lights. In the last 15 months they have placed a total of 5,641 incandescent gas lamps of the Welsbach type. These have replaced 3,720 electric lights, 1,206 oil lamps and 715 ordinary gas burners. Allowing 3 feet of gas for each burner, this will make a total consumption for the 5,641 lamps of 14,778 feet; and a decrease on the 715 gas burners displaced of 2,145 feet, or a net gain of 12,633 feet per hour to the credit of the Welsbach burner in our city. I also wish to take issue with Mr. Highlands with regard to the percentage of water gas made in the West. I do not know where he got his statistics showing that 90 per cent. of the gas made in the West was water gas; for, according to the latest statistics available, there is only 53 per cent. of water gas made in the West. In regard to getting consumers, and increasing the consumption of gas by the introduction of Welsbach lights, let me instance a case in point, in a block very close to our gas works—it was a block in which not one foot of gas had been used. The block was taken up by only small stores—druggist, butcher, grocery, etc.—and by the introduction, free of charge, and at the instance of the Gas Company, of two Welsbach burners into that drug store, we now have about 40 Welsbach burners going in that block. Every store in it is now lighted by gas. I am satisfied that our gas consumption has been increased very materially by the introduction of the Welsbach lamp; and I for one protest against the indorsement by this Association of Mr. Highlands' paper condemning the Welsbach light, or any other lamp that cheapens to the consumer the cost of gas.

MR. MILLER—This subject has been pretty well covered, but I would like to emphasize a point made by Mr. Howard with regard to the comparative cost of the Welsbach light and kerosene. Our main competitor, without any question, is oil. There are but very few houses in any town that do not burn oil in some way, and there are probably three or four houses that burn oil exclusively to every one that burns gas. The price of oil is going up every day, and it is now very high. A gallon of oil will give in light, with an ordinary lamp in good order, the equivalent of about 850 candle hours; with a high candle power lamp, or one whose efficiency is higher, this would probably be raised to 1,200. If you allow 20 candles to the foot of gas (which is fair), we get 20,000 candle hours to 1,000 feet of gas; which is equivalent to 23 gallons of oil burned in an ordinary lamp, or 17 gallons of oil burned in a high candle power lamp. At the present prices of oil and gas, allowing for the breakage of Welsbach mantles, and a large allowance for chimneys, but not allowing for the labor of cleaning oil lamps, you will find that it is cheaper to light by the Welsbach lamps than it is to light with oil.

MR. EATON—In regard to the utility of the Welsbach burner, I want to give the members of the Association some figures from my town—Jackson, Mich. One store I have in mind used three arc lights at a fixed charge of $2.50 per lamp; the current was furnished to these lamps at 2 cents per hour, making the cost of running the three lamps from $15 to $18 per month. They were displaced by 22, possibly 24, Welsbach lamps. They used them during the month of April at an expense of $2.50. Of course, for the month before that the cost would have been more; it must have been $3.50. I have in view another store (a drug store) that was paying an average of $25 for lighting; it is not now paying to exceed $7 per month, and the proprietors are better satisfied with the present than they were with their old method of lighting. In every case where we have come against the electric light we have lighted the stores with the Welsbach with greater satisfaction, and at an expense running from 25 to 40 per cent. of the former electric light bills—and we have as good an electric light company as there is in the country, which is operated by good business men, who put up their works in good shape and furnish a good light.

MR. DARRAH—I do not believe there is any other incandescent gas light in existence to compete with the Welsbach light; but the trouble with the Welsbach light to-day is the deficiency in the mantle. I have had some experience in putting them on. I have discovered that some mantles will not last 24 hours, although I have had others that at the end of six months were seemingly as good as when put on. But where you find one mantle of the latter kind you will find ten others which will not last as long. I believe it is the only way you can compete with electricity. Where I have put them on they knock the incandescent electric light right out; it is nowhere in comparison with the Welsbach. I think it would be better if each gas company would get the direct agency for the Welsbach from the original company. By doing so they can handle these lights, keep up the necessary repairs at all times, and not be subject to an agent, who will go and come only when it pleases him. An agent may leave a city or town whenever it pleases him, and then there is no one left in that locality to handle the light. Further, if the burners must pass through three agencies before they reach the gas company, there is then no profit in handling them. If they come directly from the company, then the gas company can keep up all repairs and furnish all the lights at less expense. It is the only light that can compete with the electric, and it beats it everywhere if you have the same candle power in the incandesent electric light that there is in the Welsbach incandescent. It takes a very large incandescent electric light to give you a 60-candle power light in a dwelling or store room, and the arc light is the only light that can compete with the Welsbach. Even then, for street purposes, three Welsbach lights in combination in one lamp will give you almost as much as any ordinary arc lamp for street lighting. My suggestion to my friends here is that if they can get the direct agency for the Welsbach they can make a success of it wherever it is introduced, because then they can get all the material with which to keep up the lamps at less expense than they can through an agency.

MR. NASH—One point that has not been touched on yet is the standpoint of the user—whether as electric light man or gas man. I would like to ask Mr. Highlands whether he is in the electric light business as well as in the gas business.

MR. HIGHLANDS—I am.

MR. NASH—That is what I thought.

MR. ODIORNE—I would like to ask in connection with this whether any member has introduced this Welsbach light for street lighting, and has had it in use in that way for any considerable length of time.

MR. GWYNN—I do not think there is any question but that different localities are differently affected by the introduction of the Welsbach burner. I think, as Mr. Highlands says, that in some localities where it is put in competition with the flat-flame burner, the introduction of the Welsbach will cut down the consumption temporarily. But if the business is properly worked up there is no question that in the course of time you can get back the former consumption, and with it a large increase. I know that in our city of Steubenville, O., when we commenced to use the burner the consumption was greatly decreased at the start, owing to the fact that a great many of our consumers used flat-flame burners, and that we displaced very few oil lamps right at the start; but in the course of 60 or 90 days we commenced working on the oil lamps, and found that the consumption commenced to go up. To-day it is very little behind what it was six months ago, and is still gradually increasing, and in a few months I think there will be an increase of business over what we formerly had. I think there is no question that in many localities you can light with the Welsbach for less money than you can with large coal oil lamps. The greatest effect with us has been in the displacement of the incandescent electric lights. We have displaced more incandescent lights with the Welsbach than we have coal oil lamps, but the latter have been and are also being displaced daily.

Mr. Clark—I want to answer Mr. Odiorne's question as to the use of the Welsbach for street lighting. We have a number of places where the Welsbach is used for street lighting, but not more than a few dozen have been in over a year. At the start we figured for six renewals per year. We thought that so many would be broken by the boys throwing stones through the lanterns that we might have to renew an average of six times per year. But I now believe that three renewals per year are sufficient to figure on, unless the lamps are located in a particularly bad district; by that I mean where there is a good deal of malicious mischief. We have made one contract under which we hope to place 350 lamps. There are only 200 in now under that contract, and we base our expectation of 350 on the satisfaction generally expressed with the lighting by the Welsbach lamps. We expect that more of the arc lights will be displaced, and that we shall get the lighting of the city with the Welsbach. This is not an experiment that we are making at our own cost, but we are getting a very fair profit on the light. We are getting as much as we were expecting to get, before the days of the incandescent and arc light, from the open flame street light. It is in on its merits, and the extension of the light in that city depends upon the satisfaction it gives to the people. Our experience warrants us in believing that we will get 150 more lights in that town, and the Welsbach is there largely displacing the electric arc light.

Mr. Highlands—It seems to me that I am away behind the procession in this matter. In looking over this audience I see many faces that I have seen before at previous conventions, at some of which we heard Mr. Starr's advocacy of large burners, and plenty of them. It seems to me that while I have been following in his footsteps the procession has gone by, and I do not even get into the band-wagon. One point which I think has been overlooked is that I spoke from the standpoint of a small gas works. There are in the

United States over 1,000 gas plants, and there are 45 cities in the United States with a population of 75,000 and over. A great majority of the gas works are in the small towns, where the output will of necessity be limited because the number of consumers is limited, and a great many of them cover the entire territory, and already have nearly every possible customer. Viewing it from their standpoint, replacing their burners, which now have an average consumption of six feet per hour, with burners that average, as nearly as I can get at it, only 2.66 feet per hour, it certainly looks to me like bankruptcy for those small companies. Where they will get the revenue to pay the expenses of the existing works or to extend the works already eslished is a point that troubles me.

MR. BUTTERWORTH—Is not three-fourths of the lighting in your town done with oil at present? And is there not a chance to work on that?

MR. HIGHLANDS—I will say yes to that.

MR. McDONALD—No doubt the subject is of very great interest to all the members of the Association. I had thought of putting this matter to them in a little different light from what it has been put this morning. It seems to me that it does not admit of argument. Supposing some gentleman in this room should say that he had discovered how the cost of manufacturing gas could be reduced 50 per cent.! You would welcome him with ardor, and there would not be a dissenting voice. Now what has happened? We have a burner furnished us which does that identical thing—it reduces the cost of gas. Therefore, I think it is a thing that ought to be welcomed by every gas man. The gas consumed in that burner costs 50 per cent. less than it would cost to produce the same amount of light from the same gas when consumed in any other burner in use; and it practically amounts to identically the same thing as if you reduced the cost of your gas 50 per cent. It makes a reduction in the cost of gas—a reduction not at the works, but a reduction at the point of ignition, which is the place where you want the cost of gas reduced. Therefore, it seems to me there is hardly a chance for argument on the question of the utility of this burner.

MR. J. W. STRATTON—I only want to say a word in endorsement of the sentiment expressed by Mr. Ramsdell. It seems to me it would be exceedingly inconsistent for this Association to endorse this paper —a paper which would be largely copied into the electric light journals, and which would give so much comfort to our competitors in the lighting business. Still, I agree with him in some points. I think it would be better for the gas companies, and I think it would be to the interest of the Welsbach people, if the gas companies would handle the burners, and in that way have a deeper interest in keeping up repairs. The item of repairs is a very considerable one in connection with this burner. The mantle itself is not what I think it should be or could be. However, that is a matter which will, no doubt, eventually take better shape. A Welsbach burner with a broken chimney or broken mantle is a great annoyance to the consumer; and if he cannot get repairs easily and speedily, he will condemn the burner and may condemn all lighting by gas. I think that is one of the strongest factors against the incandescent burner. The electrical men are quick to perceive this; and why we, as a Gas Association, should be called upon to give them such exceeding comfort, I, for one, cannot understand.

Mr. Clark—Perhaps the Welsbach light has had more than its share of attention to-day; but I do not want to let Mr. Highlands' statement, that the small gas companies would suffer from the introduction of the Welsbach light, go unchallenged. Anything that will cheapen the cost of gas light will certainly extend the use of gas. It is in the small towns that the consumption of gas per capita is small. It is in the small towns, therefore, that there is the greatest room for an extension in the use of gas. In large cities the people will burn gas at practically whatever cost. In New York City, for instance, the rate of gas per capita is, I am informed, 7,000 cubic feet per year. I do not believe there is in the country a town as small as Clinton, Iowa, which sells more than 3,000 feet per capita, and I doubt if one-third of them sell more than 1,200 feet per capita. It is, therefore, in these small towns that there is afforded the best chance for extension in the use of gas; and it is in these towns that the cheapening of the gas light to the consumer will result in the increased demand for gas. In that way, it seems to me, the use of the Welsbach burner will directly benefit the small gas companies. I know that, in our experience, we do not find that the Welsbach light hurts us in the small towns; and we try to push it in the small places as well as in the large.

Mr. Howard—I hope that nothing will be done to prevent the paper of Mr. Highlands, and the discussion thereon, being published with the other papers. I should exceedingly regret the suppression of that paper. I am not afraid of having the electrical papers publish it. I wish they would publish the entire thing. I think that the Welsbach Company are under a debt of gratitude to Mr. Highlands for his paper, and I hope they will see it. I trust nothing will be done to prevent its publication. I am confident that the paper will prove of benefit to the gas interest.

Mr. Evans—I believe that this Association as a body are satisfied that Mr. Highlands in presenting this paper to the Association acted in entire good faith, and that his paper is really a statement of his own experience. As I understood him, he is in the gas lighting business and also in the electric light business; and I have no doubt that in the preparation and presentation of this paper every word was written in good faith. I, therefore, move that the thanks of the Association be extended to him for his labor in preparing it.

VOTE OF THANKS TO HERR AUER VON WELSBACH.

THE PRESIDENT—There is already a motion before the house. It has been moved by Mr. Howard, and seconded, that the thanks of the Western Gas Association be extended to Herr Auer von Welsbach for his discovery and production of the gas burner; and that the Secretary transmit this expression of the Association to him. (Carried.)

MR. HIGHLANDS—As to the disposition of the paper I have read, I have this to say: I wrote the paper against my protest, and did all I could to get out of it. I stand by the assertions and statements made as to the Welsbach burner. There is no retraction at all. Whatever disposition the Association sees fit to make of the paper is a matter of no consequence to me. If you think it best for the interests of all to suppress the paper instead of publishing it, you have my hearty consent to do so. If by writing a paper in the line I have done I have succeeded in bringing about a discussion which will be of benefit to us all—as I think this will prove—then I shall have accomplished the very purpose I had in view. (Applause.)

MR. HUMPHREYS—I second Mr. Evans' motion thanking Mr. Highlands for his paper. Unquestionably the paper was prepared in good faith; and we certainly wish to show no discourtesy to him in view of that fact. Furthermore, we can at the same time congratulate ourselves on the presentation of such a paper. I agree with Mr. Howard that it cannot possibly do the gas business any harm, accompanied as it must be by a statement as to the discussion and by the resolution which has been passed. If we were to eliminate it from the minutes it might be taken advantage of by the electrical papers, and then no explanation of our action could set us straight again.

MR. THOMPSON—I think Mr. Highlands and Mr. Howard are in error in thinking that there was any suggestion as to the suppression of the paper. Mr. Ramsdell suggested the elimination of one sentence—that regarding the "ghastly glare" of the Welsbach light; that in view of Mr. Highlands' remark while reading the paper that he had not previously seen the light as exhibited in this hotel, it was suggested that that sentence be withdrawn. But there was no question about suppressing the paper itself.

MR. HOWARD—Yes, there was.

MR. THOMPSON—I think we may congratulate ourselves upon having a member who has the courage of his convictions; for it would be a great pity that any one holding views possibly not in accord with those of the majority should hesitate to express them. (Applause.)

THE PRESIDENT—You have heard the motion of Mr. Evans, that the thanks of the Association be extended to Mr. Highlands for his paper. (Carried.)

The Association took a recess until 1:30 P. M.

FIRST DAY—AFTERNOON SESSION.

The Association met at 2 P.M., and the President introduced Mr. Alten S. Miller, of New York, who read the following paper on

METAL GASHOLDER TANKS.

Gentlemen: I am at a loss to understand why your Secretary should have requested me to write a paper on the subject of metal gasholder tanks, as my experience on the subject has been so limited as to make it of very little value. Though I have just witnessed the erection of the largest metal tank in this country, my experience in the use of such tanks has been limited to one tank during 12 months. Under the circumstances, it has been necessary in compiling this paper to depend mainly upon the experience of others.

When it becomes necessary to build a new holder, it is usually desirable to select the site independently of the nature of the ground, and great inconvenience is often caused by the latter being such as to prevent the construction of a masonry tank. Even though the ground appears firm, and test holes show no unusual formation, when excavation is begun, springs, quicksands and boulders are often found that swell the cost of the tank far beyond the original estimate. You all know of cases where, owing to unforeseen difficulties, the cost of masonry tanks has largely exceeded the original estimate, and where it has been impossible to get a permanently sound tank. Such being the case, if without extra cost or inconvenience these risks can be avoided, no one would hesitate to avoid them; so it remains only to be seen whether extra cost or inconvenience would be encountered.

First, as to Cost.—If steel is used, all excavation is saved, as all that is necessary is to smooth off the top of the ground to a level surface. As the steel sides are much lighter than masonry walls, and the weight of the bottom is so small as to be scarcely worth considering, no more concrete will be necessary under a steel tank than is used ordinarily in the bottom and under the walls of a masonry tank. As a matter of the fact, less is necessary for the former tank, but for ease of comparison we will assume that the same is used in each case. The inlet and outlet connections will be shortened a few feet, and less excavation will be needed for them in the case of the steel tank. The difference, however, is so small that it is fair to assume them to be the same in each case.

In the case of the steel tank a steel pier will be used in the center in place of masonry, but beyond this the crown supports will be the same in each case. This leaves us the masonry and excavation to compare to the iron and the cost of erection.

Excavation will cost all the way from 25 to 80 cents a yard, depending upon the size of the tank and the facilities for disposing of the excavated material. It is possible to go below the former figure under the best conditions in very large tanks, and it is easy to run above the latter in the smaller sizes. Often quicksands and soft earth will cause slides so that the excavation grows to be half as large again as was planned. If much rock is encountered the cost is very much increased, especially if the stone has no particular value after it is removed. If the earth is firm a saving can be made by leaving a mound in the center, but this cannot be done unless the ground is reasonably solid. Cases have occurred where the weight of the walls and the water around the base of the mound when the tank was being filled have caused the wet mud in the mound to flow upward and break through the top. As the concrete cover is depended upon to hold the water, as soon as it is broken the tank begins to leak. Often it is necessary to pump the tank out for repairs before a holder is put in use.

The cost of masonry will vary greatly with locality, but not so much perhaps as the cost of excavation. It will vary from $10 to $18 a yard, a mason laying from 1,000 to 1,500 bricks a day, in mortar made of one part by volume of Portland cement and three parts sand. The cost of stone will vary widely, so that it is hardly possible to give a figure that would be of value outside a very small locality.

Herewith I give the cost of several masonry and steel tanks of the same size, omitting such work as is common to both:

Masonry Tank 102 Feet by 20 Feet 10 Inches.

Excavation, 34.5 cents a yard..	$ 2,268 73	
Masonry, $11.52 a yard.......	10,797 76	
Plastering.......	455 03	
Base stones and coping........	996 14	
Landing stones	114 75	
Back filling	1,084 16	
Tarring tank	149 09	
Sundries	174 13	
		$16,039 79

The cost of these items in a similar masonry tank at another point was as follows:

Excavation and back filling....	$ 2,475 00	
Masonry, 14.13 a yard........	13,795 00	
Base stones and coping........	1,674 00	
Landing stones	78 00	
Sundries.......	155 00	
		$18,177 00

A tank this size in steel, not including the cost of foundation, but including column supports, landing blocks, painting and parts corresponding to the masonry tanks given, cost $11,500. This would represent a saving of $4,540 in one case and $6,677 in the other.

Cost of an 82 Feet by 20 Feet 8 Inches Tank.

Labor, except excavation	$1,845 40	
Freight and handling	1,268 19	
Excavation, 58.7 cents a yard	2,732 40	
Pumping	724 66	
Brick	1,673 60	
Iron straps	24 95	
Sand	80 00	
Coping, base and land stones	337 00	
Cement	1,800 00	
Soap and alum wash	28 62	
Sundries	50 00	
		$10,564 82

The cost of similar parts of a steel tank this size was $7,600, representing a saving of nearly $3,000.

The cost of the ironwork on nine tanks varying in diameter from 57 feet to 125 feet 6 inches, and in the depth from 18 feet 9 inches to 31 feet, not including inlet connections or any part except those specified in the foregoing, varied from 6.64 cents to 7.45 cents per cubic foot capacity of the tank. The equivalent parts in masonry tanks cost from 30 to 60 per cent. more than this.

Maintenance.—As the steam used in heating tanks is not kept separate from that used around the works for other purposes, it is impossible to state positively from experience how much more coal it takes to heat a steel tank than it takes to keep a masonry tank from freezing, but we may approximate it. The condition of the surface will be approximately the same in each case, so all that will be necessary will be to find the heat lost through the sides of the tank.

We will assume a tank 102 feet diameter and 20 feet 10 inches deep. Temperature of atmosphere, 10° F.; temperature of water in tank, 40° F.; number of days, 150.

Rankine gives the following formula for the passage of heat through a metal plate from a liquid to air, or *vice versa:*

$$q = \frac{T^1 - T}{\sigma + \sigma^1 - \rho x}$$

q = the number of heat units passing through each sq. ft. in 1 hour.
T^1 = the higher temperature.
T = the lower temperature.
$\sigma + \sigma^1$ = the surface resistances to heat.
ρ = the coefficient of thermal resistance of metal.
x = the thickness in inches of metal.
ρx is so small that it may be ignored.

$$\sigma + \sigma^1 = \frac{1}{A\,[1 + B\,(T^1 - T)]}$$

$$A = 1.5,\ B = .0037,\ T^1 - T = 30;\ \text{hence,}$$

$$\sigma + \sigma^1 = .6 \qquad q = \frac{30}{.6} = 50$$

Fifty heat units will be lost per hour through each square foot of iron in the side of the tank. The total area of the side equals 6,676 square feet; hence there are lost 333,800 B. T. U. an hour.

Assuming that the boiler used for heating evaporates 7 pounds of water for each pound of coal, and delivers it at the tank at 212°, this will represent a consumption of 42 pounds of coal an hour, or 1,008 pounds a day. In 150 days 67½ long tons would be used, which, at $3 a ton, would cost $202.50. Assuming that the temperature never fell below 10° F., 10-horse power would be sufficient for all heating; but if, while averaging 10° F., it should at times fail to —20° F , 20-horse power would be necessary. There are few places in this country where the thermometer would average so low, so this assumption is an extreme one. In addition to the cost of heating must be added about $50 a year for painting, making a total of $252.50 per annum for excess heating and maintenance.

On the other hand, but few masonry tanks are tight, and there is a constant charge for water that is used in them; occasionally they start leaking unusually badly, and it is necessary to partially pump out the water for repairs. A hundred dollars a year is not too much to assume for the cost of water and repairs for the average 100-foot masonry tank. This leaves about $150 for the excess of the cost of maintenance of the new metal tank over the masonry tank, which is 6 per cent. on $2,500.

Durability.— Inasmuch as the steel tanks are comparatively new, it is not possible to state just what their life will be; but with proper care they should last indefinitely. The water in a holder tank is saturated with oils, and has no tendency to destroy iron. Holders begin first to corrode at the point that is in and out of the water most frequently, and when the holder is so badly rusted as to be useless, the part that is always immersed is found to be in good order. The portion of the tank that requires most attention is that just at the surface of the water, but a little attention will keep it from rusting at that point.

The single weak point is the bottom of the tank. There is no danger from within, but it is inaccessible from without, and is liable to deteriorate. It is not possible to bed the bottom firmly in cement on account of its size, but it should be grouted well, so as to exclude as far as possible all air and water. If this is done there is no reason why a bottom should not last a great many years. If the soil is fairly dry and is kept drained, the bottom should last as long as the tank.

To sum up, a steel tank is to be preferred to a masonry tank because:

1st. Its cost can be closely estimated before construction is begun.

2d. It is always possible to get a good, tight tank.

3d. It can be built in much less time than a masonry tank.

4th. It costs less.

5th. The extra heating and maintenance amount to much less than the interest on the saving.

In conclusion, I will add that I have just witnessed the completion of the largest metal tank in this country, its capacity being slightly over 1,400,000 cubic feet. When it was filled with water not a leak was discovered. It is now perfectly tight, though it has not been touched with a caulking tool since it was filled.

DISCUSSION.

THE PRESIDENT—This is a paper of great interest to us all, and it contains something new to many of us. Mr. Miller will answer any questions that any of you wish to ask with regard to the matter.

MR. THOMPSON—I would like to ask Mr. Miller if this was an ordinary tank, or whether it was of the double annular form. I understand that a patent was taken out some few months ago, by Mr. Fred Mayer, of Baltimore, for reinforcing tanks, or rather for placing above and on top of the main portion of the tank a detachable steel lining, against which the water line would ordinarily come, and providing an overflow slightly below that, so that, as occasion requires, the water can be lowered as far as the upper ring, to the end that, in case of corrosion, that part could be reached and renewed. Have you had any experience with that form?

MR. MILLER—I have had no experience with that form of tank. This tank was simply a plain one, with the bottom attached, and with no ring inside of it. In fact, you could not hold water with a tank so large as that described by Mr. Thompson, made in annular form, without very powerful bracing inside. The plates in the bottom course of this tank were the largest ever rolled in this country. They are 1 23/32 of an inch thick, 52 inches wide, and 24 feet 9 inches long. That makes the very heavy sheet necessary to hold water in a tank 190 feet in diameter and 50 feet deep. It would be hard to get an annular tank inside of that without filling it full of earth, or something of the kind, to withstand the pressure.

MR. CLARK—I would like some information as to whether the formula which Mr. Miller gives for the transmission of heat through that side of the tankplate would be affected by motion in the air—by the wind. Mr. Miller states as one of the advantages of a steel tank that it can always be made tight. Perhaps it can be, but it is not. That is just what can be said of a masonry tank. Masonry can be made tight, but it is not. I know of one steel tank that is leaking very badly through the bottom, and it is just as hard to repair as is a masonry tank. All the water must come out of the tank before it can be made tight. There are leaking masonry tanks all over the country; but that does not prove that masonry tanks cannot be made tight. Even those leaking tanks could probably be made tight and no harm done to any part of the structure. If a coating of asphalt is properly put on in the first place a masonry tank would never leak, as I believe. The advantage of masonry tanks is that when once properly finished and made tight they require no further care at all. Of course, it is necessary to keep the snow out of them, as it is to keep it out of steel tanks. There is no necessity for doing anything else to them if the tanks have been properly built and the walls properly prepared. And as to the bottom, unless located in a specially disadvantageous position, it is just as secure at the end of ten years as it was at first, and probably more so. The question of foundations has not been much referred to, and I understand from Mr. Miller's paper that he thinks the burden of proof is on the advocates of the masonry tank. A steel tank will often require piling, where a masonry tank will not; because, after taking out 20 feet of earth for the masonry tank you are very apt to get down to a foundation which is good and sound, whereas, if the surface is not good and sound, you would have to pile for a steel tank and would not have to pile for a masonry tank

MR. FORSTALL—While I cannot give any exact figures as to the cost of keeping water from freezing in a masonry or in a steel tank, I am in a position to give some comparative figures. We have one masonry tank 125 feet in diameter, and a steel tank, very near it, 50 feet in diameter. During the cold weather this winter we found that with the steam jet arranged as we had it arranged, by turning an ⅛ inch pipe inside of a 1¼ inch T, so as to make a syphon action through the T and create a current of water all around our tank, one of those jets would keep the 125 feet masonry tank entirely free from ice; but in the very coldest weather it required two such jets in the steel tank. That was for one week in the coldest weather. The rest of the time one jet had just about all it could do to keep the ice out of the steel tank; while in the masonry tank there was no ice at all.

MR. HUMPHREYS—I do not understand Mr. Miller to make it a point that it is impossible to get a steel tank that will leak. Of course we can have bad workmanship in the construction of a steel tank or anywhere else. I understand Mr. Miller to make the point that it is much easier to get a tight tank with steel than it is with masonry. The facts will warrant that claim. As to foundations, it may not always hold good; but you know that very often, if you do not disturb the surface of the earth at all, or no more than is required to simply level the surface, we can take care of very heavy weights by a proper arrangement of concrete foundation; whereas, if we cut down and disturb the original surface, we may get into all sorts of soil, some of which may give us great trouble. You will recall that there have been large chimneys successfully built on "floating" foundations, and many structures absolutely depend for their integrity upon the undisturbed condition of the original surface. That would all be in favor of steel tanks. In designing a gasholder tank, if on account of local conditions we have *any* doubt as to the excavation, a steel or iron tank should be our choice. The point that Mr. Miller makes, that you can, in the first place, more correctly estimate the first cost of a steel tank, is, of course, all-important to us as engineers.

MR. MILLER—In reply to the question of Mr. Clark, as to that formula for the passage of heat through a metal plate, I will say it is the formula used in boiler practice, in which there is a very rapid current of hot gases passing along the surface and giving off heat to the water. It is there used in the opposite direction, but it works either way, so that everything would be in favor of less heat passing through than the amounts I have allowed; because, in contact with the surface of the tank, the wind would not as a rule pass as rapidly as the gases do along the heating surface of a boiler. I have allowed a slight difference in the constant A on account of the slight difference between the condition of the surface of a tank and of the surface of a boiler. The surface of a boiler, which is very black, takes heat more easily than does the surface of a tank which is painted; but, at the same time, after it is weather worn, it would approximate that same condition. As for the foundation, I say it takes less foundation for the metal tank than it does for the masonry one, because there is less weight to be carried. The weight of the iron is so small on the bottom itself (it is only from $\frac{1}{4}$ to $\frac{1}{2}$-inch thick), that it would be practically negligible. So that all over the bottom, on the interior of the tank in each case, we have only the weight of the water to carry on the foundation. Then we have the iron sides to compare with the masonry walls. The guide framing and the weight of the holder would be the same in each case, which gives us an advantage in favor of the metal tank. Of course the weight must be carried in either case, but we have less weight in the metal tank than we have in the masonry one. I admit it is possible that we may have some swampy ground that it would be to our interest to dig out; but I also say that in a great many cases we have a good surface and a bad sub-stratum. It is very much better to know what you are going into in the first place than to dig down and get into this bad sub-stratum, and, after having made your estimate, to find that you have to dig indefinitely. One particular case I remember (and which probably Mr. Clark knows about) was where they started on the excavation of a 120-foot hole, and got nearly 300 feet before they got the tank in; and that tank is leaking to-day. As to keeping tanks tight

I think that Mr. Clark lost my point. I do not mean to say it is necessary that a tank should be tight, and that anybody can build it tight; but I do say that with ordinarily fair workmanship you can get a tank tight, and that you can keep it tight. If you put a tank on a bad foundation and let it settle out of shape it must leak. Unless you have such an enormous excess of strength in the iron that it will hold itself up when only partly supported, it must strain and leak; but if you start out with a good foundation no settlement will take place in a steel tank that would not take place in a masonry tank with the same foundation. Further, when a masonry tank settles it will crack the tank and be almost irreparable, while in a metal tank that can be caulked up and the rivets redriven. Of course the water would have to be pumped out of the tank the same as in repairing a masonry tank. So I think that as to repairs everything is in favor of the metal tank. Of course the bottom is the weak point, and it is an important thing to see that the foundation is right before the water is put in, and since the bottom is the weakest point in the whole structure it should therefore be watched very much closer than any other point. The other leaks can probably be caulked up from the outside, but those on the bottom cannot.

On motion of Mr. Butterworth the thanks of the Association were voted to Mr. Miller for his paper.

THE PRESIDENT—We will now turn our attention to the paper by Mr. George H. Harper, of Altoona, Pa., entitled

ADVANTAGE OF THE METRIC SYSTEM FOR ALL CALCULATIONS.

A very eminent writer on the metric system of weights and measures, in the opening paragraph of one of his works, makes use of the following language: "No cause, since the earliest organization of civilized society, has contributed more largely to embarrass business transactions among men, especially by interfering with the facility of commercial exchanges between different countries, or between different provinces, cities, or even individual citizens of the same country, than the endless diversity of instrumentalities employed for the purpose of determining the quantities of exchangeable commodities. For the inconvenience and confusion resulting from this cause but one effectual remedy can be suggested, and that is the general adoption throughout the world of one common system of weights and measures."

The Hon. John Quincy Adams, as Secretary of State, in a report to the House of Representatives of the 16th Congress, under date of February 22, 1821, lays down the following principles as those which must underlie any general or universal system of metrology:

First.—That all weights and measures should be reduced to one uniform standard of linear measure.

Second.—That this standard should be an aliquot part of the circumference of the globe.

Third.—That the unit of linear measure, applied to matter in its three modes of extension, length, breadth and thickness, should be the standard of all measures of length, surface and solidity.

Fourth.—That the cubic contents of the linear measure, in distilled water, at the temperature of its greatest contraction, should furnish at once the standard weight and measure of capacity.

Fifth.—That for everything susceptible of being measured or weighed there should be only one measure of length, one weight, one measure of contents, with their multiples and subdivisions exclusively in decimal proportions.

The principles here laid down have never been successfully assailed, nor can they be. On the contrary, they have been indorsed and supported by speech and pen of the very ablest thinkers, scientists and educationists of this country and of European and other countries.

If, then, it be conceded that the above definition embodies everything necessary or desirable in a universally applicable system of weights and measures, I believe the members of this Association will, without hesitation, further concede that the metric system is possessed of every essential virtue specified.

Every system of weights and measures is based upon a standard unit. The standard unit may be natural or artificial. That is, it may be an aliquot part or multiple of some unalterable property of the earth or some one of its products, or something chosen arbitrarily. The underlying idea in either case is facility for duplication, ease of verification and general convenience in commercial use.

The basic unit of the metric system, the metre, belongs to the former class, and is the one 10-millionth part of a quarter of the meridian, measured through France, from Dunkirk to Barcelona in Spain.

In the metre we have a unit which is at once permanent, easy of practically absolute verification, and of such a length that, as a linear measure, it possesses great adaptability to the mechanical arts and the needs of commerce; while its relationship to measures of surface, capacity and weight, is at once the most positive and the simplest possible, and calculated to facilitate, in the most marked degree, the interchange of commercial products among the nations.

The following tables show the multiples and subdivisions of the unit in its relation to length, surface, capacity and weight, the metre being the unit of length, the are of surface, the litre of capacity, and the gramme of weight.

Unit of Length.

Myriametre	10,000	Metres.
Kilometre	1,000	"
Hectometre	100	"
Decametre	10	"
Metre	1	"
Decimetre	0.1	"
Centimetre	0.01	"
Millimetre	0.001	"

Unit of Capacity.

Hectolitre	100	Litres.
Decalitre	10	"
Litre	1	"
Decilitre	0.1	"
Centilitre	0.01	"
Millilitre	0.001	"

Unit of Surface.

Hectare	100	Ares.
Are	1	"
Deciare	0.1	"
Centiare	0.01	"

Unit of Weight.

Kilogramme	1,000	Grammes.
Hectogramme	100	"
Decagramme	10	"
Gramme	1	"
Decigramme	0.1	"
Centigramme	0.01	"
Milligramme	0.001	"

The are is 100 square metres, and a cubic centimetre of distilled water at its maximum density, weighed at sea level, in Paris, is $\frac{1}{1000}$ of a litre, and weighs one gramme. There is thus established throughout the system a direct, simple and perfectly intelligible connection to the basic unit.

Have we not, then, in the metric system, a system of weights and measures that fully meets the needs of an international or universal code, as these needs are set forth by Mr. Adams? The standard is an aliquot part of the earth's circumference, the unit of linear measure is applied to matter in its three modes of extension, the cubic content of the linear measure furnishes the standard weight and measure of capacity, and its multiples and subdivisions are exclusively in decimal proportions.

In the "Imperial" system as used in Britain, and nominally in the United States, the unit of length is the yard, containing 36 inches; of weight, the pound, 7,000 troy grains; of capacity, the gallon, the contents of which measure 277.274 cubic inches, and weighing 10 pounds avoirdupois at the temperature of 62° F. and 30 inches barometric pressure. In addition to these standards there are in use troy weight, apothecaries' weight, cloth measure, yard measure for cotton and linen, wine measure, beer measure, dry measure, and a large number of so-called customary measures.

I refrain from giving any tables showing the relationship or the lack of real relationship, of these standards to each other, because I am convinced that the unbiased student, who looks to the "Imperial" system as a possible basis for a universal system of weights and measures, will find his difficulty to be, not the reconciliation of a few points which are now at variance with the orthodox creed as set forth, but to find even one point of agreement; or in fact anything on which a reasonable and intelligible system could be based.

If the premises be correct, that a simple, universal system of weights and measures would greatly facilitate and increase the interchange of commodities among nations, it were hard to conceive of anything better calculated to retard and discourage such commercial activity than the vast mass of ill conceived, illogical, and wholly arbitrary units, which does duty as a system in this country and Britain; the multiples and subdivisions of which are difficult to understand, hard to remember and wasteful of time, and, in their multiplicity, encourage inaccuracy.

The United States and Britain are, by their policy of isolation, the primary cause of the chaotic condition of the metrology of the world to-day, and the chief factors in preventing a consummation much to be desired. Nor is that all. They are inconsistent with themselves and with each other. In Britain a large number of "customary" weights and measures are in common trade use, which have little, if any, relationship to the legalized standards; and are, in their very nature, the cause and consequence of the lack of universality of methods so much to be deplored. In the United States customary weights and measures are equally rampant; there being almost as many legalized weights for a bushel of a given commodity as there are States in the Union. It takes 1.75 bushels of rye bought in Louisiana to make up the same measure in the neighboring State of Georgia; while a bushel of sweet potatoes bought in Iowa is short of that measure by 10 pounds when it reaches Maryland.

The standard units of weight and capacity in Britain are the avoirdupois pound of 7,000 troy grains, giving 2,240 pounds to the ton; and the imperial gallon containing 277.274 cubic inches, and weighing 10 pounds; the corresponding standards of the United States being the troy pound of 5,760 grains, giving 2,000 pounds to the ton, and the Winchester wine gallon, containing 231 cubic inches and weighing 8.339 pounds. It would, I think, require considerable ingenuity to add to all this confusion.

Could the world speak a common language as to its weights and measures, what a vast field for intelligent research would be opened up to us. All the magnificent literature of foreign learned and technical societies of every kind, as well as the invaluable matter purveyed by the technical and scientific press of this and other countries, would become common property; and while we might be unable to speak in our brother's tongue, his figures would be perfectly intelligible, inciting criticism or stirring to emulation. The chemist, the architect, the engineer and the statistician would appeal to a constituency as wide as the universe itself.

There is much even in the technical press and literature of countries speaking the same language as ourselves, which is comparatively valueless to us because the kernel is encased in a shell of long tons, cwts., qrs., lbs., imperial gallons, grains and septimeters, too hard for ordinary American teeth to break.

The commerce of over 400,000,000 of people is carried on to-day exclusively by the metric system. It has been adopted by France, French Colonies, Holland, Dutch Colonies, Belgium, Spain, Spanish Colonies, Portugal, Italy, Germany, Greece, Roumania, British India, Mexico, New Grenada, Ecuador, Peru, Brazil, Uruguay, Argentine Republic, Chili, Austria, Costa Rica, Egypt, Netherlands, Norway, Sweden, Switzerland, Denmark, Danish Colonies, Turkey, United States of Colombia, Venezuela, and is permissive in the United States of America, Great Britain, and the British Colonies.

Is not this almost universal adoption itself sufficient evidence of the universal adaptability of the metric system to the needs of mankind; and shall the English-speaking nation alone, then, whose interests in a universal system of metrology are greater than all others, retard the progress of the world? We are all creatures of circumstance, and are largely what our environment has made us, but that is no reason why we should allow our familiarity with, and filial regard for, any particular system so warp our judgment that we cannot see and appreciate the beauty and intrinsic merit of another system.

Numerous and strong petitions have from time to time been presented to the government of the United States and Britain, praying the adoption of the metric system. These petitions have been presented in this country by such societies and organizations as the National Academy of Sciences, American Association for the Advancement of Science, Boston Society of Civil Engineers, American Institute of Mining Engineers, American Medical Association, American Pharmaceutical Association, and many others. In Britain by every technical and scientific body, including the British Association for the Advancement of Science, and the Associated Chambers of Commerce. To what tribunal, then, shall we look for an authoritative deliverance on the merits, or otherwise, of the metric system if this "great cloud of witnesses" be not authoritative?

If, then, we are agreed that the metric system is applicable as a universal system of metrology, and that such a system is desirable, is it not possible for us in our individual and collective capacity to contribute something toward the advancement of the cause? Can we not, individually, persistently base all our private work on this beautifully simple system, and, collectively, make all our contributions to this Association, and the Association's records themselves, conformable to it?

There have been many objections to the metric system, but not a few of the objections do more credit to the zeal than to the intelligence of the objectors.

It has been asserted by some that the metre is not the one-ten millionth of a quarter of the meridian, because measurements taken of other arcs of the meridian give discordant results. The discrepancy arises from the fact that the earth in solidifying has been absurd enough to assume a form which is neither a true spheroid nor a true ellipsoid, so making concurrent measurements practically an impossibility. All this, however, does not impugn the measurement of the arc of the meridian on which the metre is based, which remains as a fixed and invariable standard, susceptible of the most accurate verification.

Another objection urged is the great length of the metre and its inconvenience of application to the mechanical arts. An ordinary 2-foot rule looks formidable when spread out to its fullest extent, but when folded, as the metre may be, goes into a comparatively small space. I do not think the ordinary mechanic would require to expand his rule pocket very much to accommodate a metre rule.

It has been objected to in this country on the ground that it is un-American. Is it any more so than the argument brought against it?

One objector invokes Divine wrath on the system, because, as he asserts, it is one of the offspring of the "wildest, most bloodthirsty, and most atheistic revolutions of a whole nation that the world has ever seen." It is not; but what if it were? Is a pearl less a pearl because found associated with an oyster?

I will cite but one more objection, and that, perhaps, the most amusing of all. I quote from a report of a committee of the Boston Civil Engineers' Society. "Indeed, so prominent is the theme that we are told the *Congregationalist* opposes the metric system, because it does not want to have the revised edition of the New Testament read: 'Neither do men light a candle and put it under a hectolitre.'"

In conclusion, permit me to commend the metric system of weights and measures to the careful consideration of every member of this Association. Such consideration can lead to but one result, and that is to convince him of the possible universal use of the system, the beautiful simplicity of its multiples and subdivisions, the facility it gives for rapid and accurate calculation, and, lastly, that it is the system used by a large majority of civilized nations.

It is being rapidly adopted by many of the largest manufacturing establishments in this country and in Britain, solely on its merits, and in anticipation of any compulsory legislation of any kind. Shall this Association be among the laggards in the race?

DISCUSSION.

Mr. Clark—It is very evident that Mr. Harper's paper is a difficult one to discuss, and the case is certainly well presented by him. There can be no doubt that great convenience would result from the universal adoption of a decimal system; and there can be no doubt that the metric system (whether the metre is really the one ten-millionth part of a quarter of a meridian, or not), answers every purpose that is desired. I understand that, while the United States Government has not made the metric system compulsory, Congress has passed a measure upon the subject, and that the courts will recognize transactions made under the metric system. I think the introduction of the metric system will necessarily be a matter of slow growth, as we can hardly compel the people to give up the measurements with which they are familiar. It is, however, now used largely in teaching. My son, for instance, is learning the metric system at school, and all the scientific bodies of the country use it. I think it very possible that those of us who are still young—you and I, Mr. President, and a few others—may live to see the time when it will come into quite general use in this country. I hope, if there is anything this Association or any other Association can do to hasten that day, we will not fail to take proper action.

MR. THOMPSON—For the past 23 years the principal agitation in favor of the adoption of the metric system has been by the American Metrological Society, of which Professor T. J. Mendenhall, late Superintendent of the United States Coast and Geodetic Survey, and an honorary member of this Association, is Vice-President. I have here one of the pamphlets issued by that Society, from which I beg leave to read a few extracts bearing on the difficulty of adopting the metric system: "The only real objection to adopting the metric system is that to make any improvement in our accustomed practice is difficult and troublesome; it is very much easier to let things slide. This difficulty can be overcome in business in the United States, as it has been overcome in science in the United States, and in business in Europe and South America. As an example of the former, the metric system has been completely adopted within the memory of the present generation in chemistry, from which it naturally works into use in assaying, metallurgy, pharmacy and medicine." Again—"Mr. Percival Fowler said: 'He could speak from practical experience in Spain. In a week the workmen became thoroughly conversant with meters, centimeters and millimeters; and he was certain the difficulty of changing the English system of weights and measures to the decimal system had been greatly over-estimated.'" And once more—"Mr. Hamilton Smythe said: 'In Austro-Hungary, for instance, the metric system was extensively used by engineers for their own convenience for some years previous to its general introduction. It had become the interest of contractors and workmen to make themselves acquainted with the terms of measurement, in which the plans, specifications and bills of quantities supplied to them by their employers were expressed, and thus through the medium of the working class a knowledge of the system had been extensively spread through the mass of the people before the system was made legally compulsory for the purposes of general commerce.'" In 1866 the Congress of the United States made the adoption of the metric system optional in this country, and it has since re-enacted the provision of its original action. There is one more reference here: "The agreement between the United States and Great Britain, signed at Washington, June 18, 1880, for increasing the limits of magnitude of packets exchanged through the post between the two countries, uses the gramme and centimeter, and contains no reference to any other unit of weight or measure." The American Metrological Society has for its object the increase of the use of the metric system for the great convenience of comparing reports between the scientific bodies of this country and of the other countries of the world. It provides for its fellows, members and associates the various periodicals, pamphlets and printed matter of the various concerns which may join. It provides for the membership of individuals and of organizations on the basis of the payment of $5 per year for members. In view of the final sentence of Mr. Harper's paper, "Shall this Association be among the laggards in the race?" I would present the following preamble and resolution:

WHEREAS, the metric system of weights and measures is the most convenient and scientific method of measurement, and is destined eventually to displace the system now in vogue; and

WHEREAS, The Western Gas Association recognizes the importance of supplying scientific as well as practical data in the reports of its proceedings; be it

RESOLVED, That this Association authorizes the use of metric equivalents, as well as customary values, in all papers and reports; and be it

RESOLVED, That this Association enter the membership of the American Metrological Society as the Western Gas Association.

For my own part, in any paper which I may prepare, or in any report I may present, I pledge myself to use the metric equivalents as well as the customary equivalents. I move the adoption of the resolutions I have read. (Seconded by Mr. Forstall.)

MR. GREENOUGH—I think that is, with great respect to Mr. Thompson and the gentleman who has read the paper (Mr. Harper), pushing the Association a little too far. I see no reason why any gentleman may not present his reports or papers in expressions of metrical equivalents if he pleases to do so; but I must say they will be only more or less intelligible to nine-tenths of us, while in our everyday business affairs we shall have to continue to employ the more familiar terms of cubic foot, yard and bushel. And as for saying, as the framer of this resolution does, that the question of the adoption of the metric system is simply a question of a short time, I cannot agree with him.

MR. THOMPSON—I did not say in a short time; I said "eventually."

MR. GREENOUGH—I question it extremely. I do not see that they have made any substantial progress in either Europe or America in the last fifteen or twenty years. The two great trading countries of the world, who do nine-tenths of the business of the world, do that business wholly on another basis; and I cannot see that in either of those countries they have made the least progress in the general adoption of the metric system. I question very much whether the change from our present system to the other is going to be anything like as rapid as was anticipated a few years ago, when the question was first agitated. I think it is a little premature for this Association to take the step proposed.

MR. THOMPSON—I trust that this resolution will be fully discussed before it is put to a vote, because Mr. Greenough misapprehends my intention. It is not the idea to do away in any degree with the customary methods. It is not the idea that any report shall be made in the metric system wholly. The idea is that parallel columns will be given, so that we shall more rapidly accustom ourselves to the consideration of metric equivalents, as well as the customary equivalents; not that the metric equivalents shall displace the customary.

MR. HUMPHREYS—Will not Mr. Thompson explain what the membership of this Association in the American Metrological Society involves?

MR. THOMPSON—Membership in that Society provides for the receipt by the Association of all the papers and reports of the action of that Society; so that we are constantly provided with the data and reports of the work being done by the Metrological Society. It provides also for the representation of the Association, by some duly authorized individual, at the annual meetings at Washington, and for voting by proxy on any question if a representative is not personally present. My object in moving to join that Society was more especially that we may be possessed of the information which the Metrological Society is constantly disseminating. I will add that the expense of membership is only $5 per year.

On the adoption of the resolution a standing vote was called for, and it was determined in the affirmative by a vote of 15 to 7.

MR. MILLER—If the discussion of Mr. Harper's paper is still in order, I would like to suggest that one side of this question has not yet been touched upon. In the shops of Germany and of France the inch is used for all gauges, taps, dies, bolts and such things. They found from experience that the metric measure was not adapted for shop practice. They find that the measurement of their gauges and standards in millimetres is too fine, and so they take inches and fractions of inches; and they have the same gauges, taps, dies and shop standards that we have in this country. As a matter of fact, their fine machinery to a large extent is supplied from here. This is on account of the fact that the metric system is not, in their experience, found adapted to shop work. I think, in the gas business, a very large amount of our work is done with dies and gauges. Before we go into the subject very deeply it would be well to see how much is done in inches practically and how much that would vary from our shop standards; in other words, how much of our work is shop work and how much is scientific work. Of course, in this country at the present time a very large proportion of the chemical and physical work is done in the metric system, and is so recognized. Of course, if we do any fine physical work it would be proper to put it in the metric system; but almost all of our work is in American measures. We buy in dollars and cents and in American measures; and I think we would be more likely to be free from mistakes by using the measures with which we buy and sell.

Mr. Clark—Mr. Miller has called our attention to the fact that we are using in our currency the decimal system. The statement has been made that the millimetre is too fine a measure for use in making dies. But the centimetre may not be, or if it is the decimetre is not. The matter is subject to as many subdivisions as is the inch or the foot, and the fact is that decimals of the inch and of the foot are used in making dies. I cannot discern, therefore, any great difficulty in using the metric standard. I do not understand that any reference is made to the difficulty of measuring anything by millimetres. We have heard that the United States and Great Britain, the great trading nations of the world, have not adopted the metric system, but the United States has adopted the decimal system in its currency. And while I have not had the advantages of some of the gentlemen here in becoming familiar with English money, and perhaps if I had I would not find the trouble I now have, certainly pounds and shillings do not convey to me the ideas that dollars and cents do. These great trading nations, the United States and Great Britain, have been straightening out everything else; they have been making trade easy (barring the tariff) in every direction possible, and there can be no reasonable doubt, I think, that the time is soon to come when they will remove this final obstacle to easy trade and easy calculation and come to the metric system, or at any rate to the decimal system.

Mr. Miller—In speaking of the use of the metric system in gauges, etc., for shop practice, I was not figuring on probabilities, but was speaking of what is actually done in those countries and of the excuse they give for doing it. They say that the inch standard is better adapted to shop practice than is the metric system. I have never gone into the question in detail; and I simply know the fact that these metric nations are using the inch standard in their shops, and that that is the excuse they give.

On motion of Mr. Jenkins (seconded by Mr. Miller) the thanks of the Association were voted to Mr. Harper for his paper.

The President—Mr. F. L. Slocum, of Pittsburgh, Pa., will read the following paper on

ACETYLENE.

History.—Acetylene (C_2H_2) was first discovered and isolated by Davy[*] in 1837. He obtained it from the black mass produced in the manufacture of potassium. In 1858 Perrot[†] produced acetylene gas by the action of the electric spark on the vapors of alcohol and ether. Quet[‡] observed that the gas formed by electrolytic action on ethylene gas in alcohol was taken up by sub-chloride of copper and chloride of silver, forming a very high detonating compound. In 1858–59 Berthelot made a much more thorough examination of acetylene and its compounds, and established its properties in general.

There are many ways of producing acetylene, such as passing hydrogen between the poles in an electric arc or by exposing marsh gas or coal gas to a very high heat or an electric spark; but up to within a recent period the most practical way of producing acetylene was by the incomplete combustion of coal gas, as, for example, in the case where a Bunsen burner strikes back and burns inside the tube. The acetylene, which is always formed by the incomplete combustion of hydrocarbons, is in this case only partially burned, and can be collected in a solution of sub-chloride of copper, with which it forms an insoluble compound—$C_2H_2Cu_2O$. This material, when dry, is very explosive and difficult of manipulation; hence acetylene up to the present time has been very difficult to produce in quantity in a pure state. In 1862 Woehler[§] produced calcium carbide by heating a mixture of lime, zinc and carbon to a white heat. He found that the black mass formed would liberate gas when brought in contact with water. He tested this gas in the usual way, proved it to be acetylene, and promised, in a very short article which he wrote on the subject, that in the near future he would give a detailed analysis and full description of this method of producing acetylene; but Providence decided otherwise, as the Doctor died shortly afterwards and never finished the work he had in mind. From that time until last year the production of acetylene, when wanted for experimental purposes, has been produced by the old method—the incomplete combustion of hydrocarbon gas. In 1893 H. Moissan[‖] produced a calcium carbide, but did not make a thorough examination of same.

In 1894[¶] he produced calcium carbide by the action of the electric furnace on lime and carbon. The examination and analysis showed that its composition was CaC_2. Moissan is, therefore, the real discoverer, after Woehler, and the first discoverer of the production of calcium carbide in a commercial way. Moissan has been experimenting for years with the high temperatures produced by the electric furnace, and has made many very valuable discoveries, especially the production of carbides of different elements; as, for example, he has lately produced a very pure carbide of aluminum, which, when brought in contact with water, produces marsh or natural gas (CH_4)- -$Al_4C_8 + 12H_2O = 3CH_4 + 2Al_2(OH)_6$. This is very interesting, as it is the first practical indication of the real sources of petroleum. The large amount of work that has been done with the high temperature of the electric arc shows that a whole series of carbides existed when higher temperatures were obtained than those within the present reach of human means, up to the time of practical operation of the electric furnace. In former ages large masses of more or less pure oxides of different elements could have been brought in contact with carbon at very high temperatures, forming carbides. These carbides were deposited in the lower and heated measures of the earth's crusts, and, as they gradually cooled, water, in the form of steam under enormous pressure, was brought in contact with them, producing many of the different hydrocarbons now found in nature. Moissan has lately made some nitrite compounds of different elements, which, when brought in contact with water, produced pure ammonia. These are mentioned especially to give an idea of the range of this class of compounds, if a certain temperature can be obtained and maintained in any quantity. There have been within the last eight months numerous articles in the various technical journals as to the cost of the production of acetylene, and the gas fraternity in general have been very much agitated by at least some of these articles, which would lead the reader to believe that acetylene was cheaper than daylight. Acetylene, or rather calcium carbide, has as yet not fulfilled the assertions of many of the articles written, and is not at present on the market at daylight prices.

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[*] Liebig's Annalen, vol. 23, p. 114.

[†] Liebig's Annalen, vol. 108, p. 114.

[‡] Liebig's Annalen, vol. 108, p. 116.

[§] Liebig's Annalen, vol. 124, p. 220.

[‖] Compt. Rendus, vol. 115, p. 1,031.

[¶] Compt. Rendus, vol. 116, p. 1,222; vol. 118, p. 501.

Properties.—Acetylene (C_2H_2; Molecular weight, 25.94; $C = 92.31$ per cent.; $H = 7.69$ per cent.) is a colorless gas, having a peculiar, disagreeable and penetrating odor. Its specific gravity is 0.91 observed and 0.89829 calculated. It is gas at all ordinary temperatures and pressures. Its critical point is 37.05° C. and 1,000 pounds pressure. Above this temperature the gas cannot be liquefied, and is governed by the laws of permanent gases. At a temperature of 1° C. and 706 pounds it is a liquid. When liquefied it is mobile, colorless, highly refractory and lighter than water, and is a very strong solvent of fats. One litre of acetylene weighs 1.16148 grains; one cubic foot weighs 507.5338 grains, or 0.07255 pounds; 1,000 cubic feet weigh 72.55 pounds. It has a heating capacity of 11,923 heat units in Centigrade and Kilo systems. Its heat value, pound for pound ($carbon = 1$), is 1.48. Its heat value, volume for volume ($hydrogen = 1$), is 4.53.

The most interesting property of acetylene to the gas manufacturer is its extremely high candle power, being 240 candles, with a consumption of 5 cubic feet of gas per hour. The comparison of its luminosity with that of other well-known compounds, as made by Prof. Vivian B. Lewes, are as follows, all based on an equal consumption of gas—viz., 5 cubic feet per hour:

Methane	5.2	candles.
Ethane	35.7	"
Propane	56.7	"
Ethylene	70.0	"
Butylene	123.0	"
Acetylene	240.0	"

Calcium carbide (CaC_2), a bluish-black, solid, crystalline, brittle mass, having a specific gravity of 2.22, can be heated to a red heat in an atmosphere of nitrogen without decomposition, but is immediately decomposed when brought in contact with water into calcium hydrate and acetylene. The reaction is as follows: $CaC_2 + 2H_2O = C_2H_2 + Ca(OH)_2$. As stated above, this interesting compound was first discovered by Woehler, and its practical production by use of the electric furnace by Moissan. There has been a great deal written in the last few months in regard to the cost of calcium carbide: Willson has put the price at $15 per ton, others at $40, and still others at $100, and so on. In this country and in Europe there have been formed numerous companies, both large and small, to promote and further the industry of gas manufacture by means of calcium carbide, but as yet there is but very little calcium carbide on the market. The writer is interested in a business where we have an electric current of sufficient voltage and amperage, and a furnace of sufficient capacity to produce calcium carbide in very large quantities. We have given some time to the production of this material. We find that the arc works entirely on resistance, and that the mass, before combination and after, is almost non-conducting; therefore, the production of carbide must must be exceptionally small for a given amount of current. Nearly all the calculations that have been published have been theoretical, and of little use in estimating the real cost of the manufacture of calcium carbide. The Aluminum Industrie Actien Gesellschaft, in Neuhausen, Switzerland, who are exceptionally well located for the manufacture of this material, are advertising it at 5½ cents per pound. This is 14¾ cents per pound for acetylene contained therein. As acetylene weighs 72.55 pounds per 1,000 cubic feet, this would make it cost the consumer $6.20 per 1,000 cubic feet.

From our experience in the manufacture of calcium carbide in a large way, we believe this to be a fair selling price, giving an ordinarily fair manufacturer's profit. Assuming this to be the case, the acetylene question, so far as the gas manager is concerned, for the use of enriching or illuminating, becomes of little interest. There is, however, one use to which acetylene can be put by the gas manager, even at its present price, which makes it of extreme interest to the manufacturer of any kind of gas for lighting purposes throughout the whole civilized world, and that is its use as a light standard or unit. For the measurement of light it is apparently the perfect standard for a light unit, as the requirement for an absolute standard of light is a gas which can be produced always in a like state of purity in all parts of the world, preferably by means of decomposition of a substance in water, so that at a given temperature the gas will always contain a certain percentage of moisture. This gas must be a definite compound, and be composed of the illuminating principle itself. It can then be burned at a certain speed and height through a specific gravity tip burner, and thus always give, constantly and exactly, an even and constant amount of light per unit of time. Acetylene manufactured from calcium carbide fills each and all of these conditions. In a recent very interesting paper by Prof. Lewes, he showed quite conclusively that acetylene was the luminous principle in all hydrocarbon flames. Therefore only acetylene, when burned in its pure state, would be able to give a constant luminosity. The apparatus necessary for the production of sufficient acetylene for light unit uses on the photometer is very simple. All that is required is a small holder in which the gas is taken from the top, working in a tank in which it can be sunk entirely below the water level. A small enlargement is made on one side of the holder basin, passing to the bottom, and of sufficient size to allow a wire gauze holder about two inches in diameter to be passed to the bottom and under the holder. The amount of calcium carbide necessary is then wrapped in the wire gauze, pushed down under the surface of the water, and the acetylene gas allowed to escape for a few seconds, or until all the air is removed from the mass, and then it is passed to the bottom and turned underneath the holder and held there until the holder is sufficiently full. The holder is then allowed to stand until the temperature of the water is constant and near 15° C. The percentage of moisture in the gas has then become constant. The gas is burned under a given pressure through a special tip, the same that is used for specific gravity determinations by diffusion. The writer anticipated giving the results of tests with photometric measurements, in comparison with normal candles, but has been unable to do so, and reserves this for a future publication.

In regard to the future of calcium carbide: There seems to be little hope of its general use as a competitor of coal and water gas. Its chief uses will likely be in lighthouse work, isolated lighting plants, possibly in car service, in the use of light unit and special purposes where other gas is not available, or where extremely high candle power gas is necessary and the present price is not prohibitory. It is going to be an industry that will gradually grow, and it is possible the production of carbide will become much cheaper than at present, although there is no indication of any great cheapening in its manufacture, from our present knowledge. Its use will likely be very extended in the general technical world; in fact it is of far more interest in the numerous branches of organic chemistry than in the field of gas making.

In regard to its transportation in quantity. It is best shipped in cans, tightly sealed. There has been a company formed in Philadelphia to manufacture acetylene and compress it in cylinders in a liquid form. This seems very much like "carrying coals to Newcastle," as a ton of calcium carbide will yield over 750 pounds of acetylene, and it is certainly much more convenient and in much smaller space than if acetylene gas were compressed into cylinders. The cylinders would necessarily have to be about the same as those for the transportation of carbonic acid gas, as the critical point of the two gases lies at about the same temperature. It would, therefore, require about 40 cylinders to transport the equivalent of one ton of calcium carbide, and the danger of explosions with liquefied acetylene would be very great. It is not a question of what to do with acetylene, or how to produce it, with the gas manager, but it is a question of "How cheap can I buy calcium carbide?" and, as yet, calcium carbide cannot be produced at a figure which would make it available for any ordinary uses in the manufacture of gas, and the state of the art does not indicate that it will for a long time to come.

At the conclusion of his paper Dr. Slocum gave an exhibition of the lighting value of acetylene, burning the gas through 1, 2 and 3-foot tips.

DISCUSSION.

THE PRESIDENT—We have listened to a very interesting paper, and would like to hear from some of the members on this subject.

MR. GREENOUGH—I think there is a great deal to interest us in that paper. The writer seems to have approached the question of cost from the most sensible point of view. I would like to ask Mr. Slocum, with regard to the figures he gives us here, for it seems to me they do not correspond exactly in the book; but perhaps it is owing to a misprint. He says that the cost of the calcium carbide would be 5½ cents per pound. That, as I figure it, would be $110 per ton; and that would make the cost of 1,000 cubic feet $11, and not $6.20, as stated by him. Figuring, as he says afterwards, that it would be 14¾ cents per pound for acetylene, and estimating that it would weigh 72½ pounds per 1,000 cubic feet, then 14¾ cents per pound would make the cost $10.70 per 1,000 cubic feet

DR. SLOCUM—That is a mistake in the calculation. The 14¾ cents per pound for acetylene is all right, but the $6.20 per 1,000 is wrong.

MR. GREENOUGH—Then it would be $11 per 1,000 cubic feet instead of $6.20?

DR. SLOCUM—Yes.

MR. THOMPSON—Then will Dr. Slocum kindly read as it should be the paragraph he is talking about?

DR. SLOCUM—Wait until I make the calculation again and figure it over. The selling price is 5½ cents per pound. That is 14¾ cents per pound for the acetylene contained in the calcium carbide. As acetylene weighs 72.55 pounds per 1,000 cubic feet, that would make it cost the consumer $10.69 instead of $6.20 per 1,000 cubic feet. There is a mistake in the calculation.

MR. GREENOUGH—This does not in any way detract from the value of the paper; and I wish to compliment Dr. Slocum upon the care and attention he has given to the matter; and I move that he be given a vote of thanks for it.

MR. E. C. BROWN—Before that motion is put may I be allowed to ask Dr. Slocum a question or two. There has been a good deal said about carbide of calcium in the last few months, and some questions have arisen which I do not think have been satisfactorily answered. As Dr. Slocum is a practical worker in that line, I would like to ask him if the process involves the use of fire around the crucible, or does he rely upon the current to maintain the fusion in a heavily lined smelting furnace?

DR. SLOCUM—We have methods of using both—with the gas around the crucible and without it. But the temperature around the furnace, in the case of the calcium carbide, is only an auxiliary heat; it is not a melting heat. The lime and the carbon, before this formation of the calcium carbide, have a slight amount of conductivity, but it is very slight on account of the non-conductivity of calcium oxide (CaO), it being nearly one-half lime, so that there is practically no conductivity at the very beginning. As soon as the calcium carbide is formed, there is practically no conductivity in the mass, especially at the point of fusion. Consequently the current works down through, almost unresisted, as if the lime and carbon were not there; it is but slightly affected, and you have got to work right down through on resistance. You can use a bundle of ordinary electric light carbons in order to get the greatest work out of the furnace, and so that you can pass through all the materials underneath. And then, when you do get it formed, it is exactly like slag; it is a great deal harder to handle than the slag from steel, because the steel slag runs easier than the carbide. Consequently you have in this carbide a nasty stuff to handle. It is hard to get your mass formed, and it is hard to handle any reasonable amount. This all costs, especially when you cannot get it to move fast. Therefore, the formation of it in large quantity is very difficult in the electrical furnace as now constructed. Now, if the current in going through from the positive to the negative pole does not come in contact with any calcium and carbon on its way to the regular pole and convert it, it is gone, and the force is lost.

MR. E. C. BROWN—Perhaps you can also tell me what is the latent heat of evaporation and the specific heat of acetylene?

DR. SLOCUM—I have not got the figures here.

MR. CLARK—It seems to me we ought not to congratulate ourselves that acetylene is a high priced article. Gas men have been very prone, I think, in the last three or four months, to wish that it might prove to be a high priced article. But it seems to me, if we could welcome the production of acetylene on a commercial scale, it would do us as much good as any other improvement possible in the production of gas. Certainly, if there is any benefit to be derived from the production of acetylene on a commercial scale, it would be derived by gas companies. Has Dr. Slocum's work been done with the direct or with the alternating current? And will he tell us what difference there is in point of economy between the use of the direct and the alternating current?

DR. SLOCUM—Our work has been entirely done with the direct current. We have done no alternating current work whatever. We also were very much in hopes that acetylene would prove a commercial article, and we tried very hard to make it so. I think we are in a position to manufacture it as cheaply as anyone away from Niagara Falls. The Pittsburgh Reduction Company have been working at it at Niagara Falls, and their Company have also been working at it; but they are not any better satisfied over their results than we are with ours.

MR. HUMPHREYS—Dr. Slocum refers to the fact that he expects to do some more experimental work in the line of employment of acetylene as a photometrical standard. I think anything we can say to encourage him in that direction we ought to say. It is manifest to all of us how desirable it is to have a new standard of light. While I am not by any means of those who claim that the candle is absolutely valueless as a unit of measurement in photometry, still I think we ought to be able to improve upon it; and it would seem here might be a field for most valuable work for all of us; and it is something that we can afford to welcome. As to whether we should as gas men in general welcome the production of acetylene on a commercial basis I am in doubt. It depends upon how carefully it is covered by patents, and who owns them.

MR. MCELROY—I wish to say, with regard to Dr. Slocum and his experiments, it is not his fault that he has not been able to demonstrate that acetylene would be produced on a commercial basis. He was willing, but the flesh was weak, and he had not the time. I know that his time has been fully occupied. I could not go into my office to use the photometer but I would find him busy, night and day. He has been working at night to complete the experiments, but he could not do it. So I think he ought to be thanked for what he has done.

MR. HUMPHREYS—I second Mr. Greenough's motion that a vote of thanks be given to Dr. Slocum for his paper, and for the attention he has given to this subject. (Carried.)

THE PRESIDENT—We will now hear the paper by Mr. James T. Lynn, of Detroit, Mich., on

EXPERIENCE WITH FOUL GAS.

There is probably nothing more distasteful to the average gas man than the knowledge that he is passing sulphureted hydrogen to his consumers in a proportion such as to cause annoyance and consequent complaint. There are but few of us who have not met with this difficulty, and very often too have found that such trouble has been the result of faults very difficult to locate. I can conceive of no better method to assist others to whom such experience may come, than to cite an occurrence of some years ago, which came to my attention while engaged as general utility man about a gas works.

The plant referred to had practically been allowed to take care of itself for some time before the new superintendent had taken charge, and one of the first discoveries made was that the gas was so foul that it was almost an utter impossibility for citizens to hold meetings in halls, theaters, churches or any other place where a large number of burners was in use. As the trouble was occurring in December there was no possibility of obtaining ventilation without considerable discomfort to the occupants of such rooms. Meters were ordered to be removed from private residences, as the large quantities of sulphur inhaled had caused a serious epidemic of coughing in every house in which large numbers of burners were in use. As this was prior to the days of electric lighting, it was a matter in which the city as well as the individual was interested, all public places and streets being lighted by gas. Matters had come to such a pass, indeed, that a committee from the city council had been appointed to investigate the trouble and report the results of their investigation to that body.

In our attempt to discover the origin of the trouble we first tested our gas at the purifiers, the paper remaining as clean after the test as it had been before, showing clearly that the difficulty was not the result of dirty material. A second test at the inlet of the station meter showed very evident traces of the objectionable sulphur, and thus indicated beyond a doubt that the cause of its presence was a leaking center seal. As soon as possible we removed the cap from this, cleaned all the joints thoroughly, covered them with tallow, and then replaced the cap. You can imagine the great comfort we derived from our discovery that this labor had neither removed nor lessened our difficulty. The gas remained as before, clean at the test cocks on top of the purifiers, and foul at the meter inlet.

Again we removed the cap, faced the joints with scrapers and replaced it, but found by testing that our former results remained unchanged. For the third time the cap was taken from the center seal, the water was entirely removed, and upon an examination of the divisions we found in one of them a crack extending from the bottom to within about one-fourth the distance from the top. Foul gas had been passing through the center seal to the meter, into the holder and on to the consumer. We realized that the removal of our old center seal and setting of a new one was to be no small undertaking at that season of the year, when the output was at the maximum limit. In fact, such work with a 12-inch center seal, and only one set of purifying boxes to rely upon, is never to be considered a trifling matter when one possesses a holder capacity equivalent only to the minimum consumption of one day. Necessity, however, often removes obstacles and converts timidity into boldness. At any rate, we settled down to work.

Immediately after the arrival of a new center seal, temporary galvanized iron pipe connections were made from the inlet pipe to our center seal, and the inlet of our most convenient purifier, also from the outlet of the latter to the pipes carrying our product to the station meter, which threw our remaining three boxes and center seal out of operation. We soon had the center seal and the old connections removed, new foundations built throughout, our new seal placed, and all connections made again, this work being accomplished in the course of three days. During the time this was in progress we were compelled to change the material in the box which was in use each day. In order to do so we fired a couple of extra benches, and were able to close down our entire works for about three hours each morning. After our center seal was in position we broke the temporary connections with the box, connected the center seal and the remaining purifiers, filled them with material, recommenced operations, and then easily connected the other purifier with the seal. But this was not the end of our trouble. The former condition of affairs had existed for such a length of time that the water in the station meter had become impregnated with sulphureted hydrogen. This water was taken out and the meter refilled. This was a small matter, and a test of the gas between the purifying apparatus and street governor showed no trace of impurity. It ran all day without showing any discoloration of the test paper in the glass, but with some surprise we found the next morning that foul gas had discolored it, giving evidence that such gas had passed into our street mains. This paper was removed and another placed in the glass, and as on the previous day it remained clear, but on the following morning was as black as the former one had been.

It annoyed us greatly to think that we had made pure gas during the day and foul during the night; so upon the third night the gas passing to the street mains was very closely watched. We found when the holder commenced to descend the paper began to discolor. This fact led to the discovery that the outlet pipe from the holder was being used as both inlet and outlet by the agency of an open by-pass valve, and that during the day, when our make exceeded our output, a sufficient supply of gas was sent to our consumers without entering the holder at all, but that, after the heavy consumption of gas came on at night and was in excess of the make, then of course the deficit was made up from the gas in the holder. The next morning, by means of a test made at a pillar cock placed on the crown of the holder for the purpose of testing, we were convinced that the trouble now existed here. We could not change the water in the tank as we had that of the meter, for at that time our daily output of gas was over 240,000 cubic feet, with a storage capacity of only 100,000 cubic feet.

The following plan of cleansing the water was devised: We had the cover of an old purifying box, about 10 feet square and 14 inches in depth; this we elevated about six feet above the water level of the holder tank by means of empty barrels, and filled it with a mixture of lime and water. Then we constructed a siphon of 3-inch pipe, about 8 feet long on one side and 3 on the other. Late in the afternoon, when the holder was filled to its utmost capacity, we would drop this siphon down alongside the holder, give it a quarter turn, then raise it up far enough to bring the inside siphon end above the water level, connect it with an outlet from the box, and by opening a cock run the lime water in from the elevated box. This process was repeated for several days until the water in the holder tank was entirely free from sulphur. Before lime water was introduced into the tank the water it contained was very dark, almost black, but as it became purified, and the sulphide of calcium formed by the chemical reaction was precipitated, it became so clear as to expose to view the guide rails and bolts for several feet below the surface.

After we had disposed of this embarrassment, it was concluded to examine the inlet to the holder. This had been by-passed for some years, owing to a leak which had filled the pipe so fast that it was impossible to make use of it. We pumped out the water and found that the leaks were all stopped, the inlet being now more nearly water tight than the outlet, which had for so long a time done the work of both. As the siphon had been used very near the inlet and outlet pipes, my opinion is that the lime had filled small holes left in the joints beneath the level of the water, causing these leaks; or that there had been small solid particles, capable of swelling by the action of water upon them, dropping into the tank at times during the years past and accomplishing the same result. At any rate there was no further trouble with foul gas, nor by too much water in the drip of our inlet connection.

This experience demonstrated to me that it was a good plan to have a by-pass arrangement between the inlet and outlet pipes of all gasholders. In the construction of two plants since that time I have followed this plan; but I would not advocate the use of this by-pass except in an emergency, because of the following facts: Where coal gas is made exclusively the candle power of the product is irregular, the illuminating power of gas made being variable between charges. In the manufacture of water gas the results obtained are just the opposite to those obtained from coal gas, the candle power of the gas being much greater toward the end of a run.

A very positive young man, engaged in the gas business as manager of a small gas works, with whom I came in contact a few years ago, remarked to me that it was not necessary for him to make frequent tests for sulphureted hydrogen. He explained his position by the assertion that he knew precisely the amount of sulphur the coal employed in his works contained, and also the exact length of time each purifier would continue to extract the impurity. I had that evening, while in a room at the hotel, my only experience with the product with which this young man was supplying his customers. I had scarcely lighted the gas when I detected a very visible odor of sulphur, and immediately wending my way to a neighboring drug store, purchased the necessary materials and returned to make a test at the burner. The result showed the presence of the objectionable article, which did not surprise me. It simply illustrated the fact that at least one young man's mathematics was not equal to a common and simple test. In explanation of the fallacy of his calculations, I may relate an experience then fresh in my mind, of two successive consignments from the same coal mines to the plant with which I was at that time connected. I found that the gas produced from the first excelled that from the second by over 3 per cent. in yield, 5 per cent. in candle power, and required but 70 per cent. as much material for purification, with heats and other conditions the same throughout the entire time.

In many small works throughout the country, especially where capital to make necessary improvements is wanting, the meagerness of the purifying capacity is the cause of considerable annoyance to superintendents and to consumers. It is apparent that in earlier years constructing engineers neglected, to a surprising extent, the erection of apparatus adapted to an increased production and changes in the condition of material. It is worthy of remark that more attention is paid to this important department at the present day, as may be readily seen by the following quotation from a well known constructing engineer of the present time, who, upon being asked what rule he followed in erecting purifying apparatus, replied, "As much superficial area per 1,000 cubic feet as a gas company's finances permit." Looking at the matter with open eyes and reasonable minds, the good common sense of that reply can be readily seen. The question of the superficial area of purifiers has been almost worn out in discussions and in books, and while much valuable material has been gathered upon the subject, rules are at variance and none are adapted to the possibilities of the future.

In order to avoid the ills arising from the passage of foul gas into our street mains, there are well-known remedies generally admitted but very frequently not adopted. At the present time of sharp competition we are compelled to satisfy the public, or suffer in consequence a decrease in our business; and while everything is going on smoothly at the gas plant and upon the street, alertness is the only key to security. The urgent demand for a pure article is an undeniable one, and the importance of frequent tests for sulphur is self-evident. Tests should be made not only at the purifiers, but also at some point between them and the station meter; and occasionally it might be found advantageous to make a test at a burner in the office or the home. By attending strictly to this matter one can always be positive in regard to the condition of his gas and of the apparatus in operation. Small imperfections are apt to present themselves at the most unexpected times, but if immediately discovered and remedied are not so troublesome as they would become under a system of neglect.

At the works of the Company with which I am now connected the manufacture of a pure standard gas is made imperative by the provisions of the charter under which we operate. Consequently, we subject our gas to a constant test for both sulphureted hydrogen and ammonia at the photometers, having three glasses in position, two of which are connected with our coal and oil-water gases between their respective purifiers and station meters, and the third making a test of our mixed gases on the passage from the holder to the street mains. By watching the test closely, and noting the most minute discoloration, the presence of the slightest trace of any undesirable impurity is readily detected in ample time to prevent all unpleasantness.

In writing this paper the thought that my own experience might be of some benefit to others presented itself. If I have succeeded in preparing some, to whom similar experiences are as yet unknown, to surmount an obstacle that may arise at some future time, and if in my effort to do this I shall have succeeded in interesting others more able than myself to participate in a beneficial discussion upon the subject, I shall feel that my object has been fully attained.

DISCUSSION.

THE PRESIDENT—Mr. Lynn's paper is likely to be of benefit to us, and I am sure he will be willing to answer any questions about the subject matter.

MR. JENKINS—Some years ago I had a very similar experience to that related by Mr. Lynn. The only difference was that I did not have any defective center seal. I found on taking charge of the works that they had allowed unpurified gas to pass from the works into the streets for several weeks previous. I had made quite a number of tests. I knew that my gas was right when going into the holder, but had not tested it going out. A civil engineer took the trouble to test it, and called my attention to the fact that the gas was no better after I had been there six months than it had been before, and so proved that I was a failure. I looked the matter up and found that the water of the gas holder was so very foul that you could send absolutely pure gas into the holder and as it would come out it would discolor the test paper right along. We were more fortunate than Mr. Lynn, however, for having two holders, we emptied the tank, putting in fresh water, and had no further trouble.

Mr. Butterworth—I would ask Mr. Lynn if he could not have temporarily packed that crack in the center seal, making it in that way temporarily tight, and thus get along until summer time, when his works could be repaired. He says that the rule for erecting purifying apparatus is that it should be by the "superficial area per 1,000 cubic feet." I think that what he means is the cubical contents of the box. The superficial area is not what we are after; it is the cubical contents.

Mr. Lynn—In regard to packing the crack in the center seal, on the divisions in the center seal, as every person knows who knows anything about the casting of center seals, the strain is very great; and if you attempt to pack a crack in any division of a center seal you are liable to crack it all the way up. It does not take very much of a strain on such castings, in addition to the strain which is naturally on them, to break them; and any caulking you might attempt to do on them would simply extend the crack to the point probably of causing it to crack all the way up.

Mr. Ferrier—Mr. Lynn mentions an experience with two successive consignments of coal from the same mine, and states that the gas from one required but 70 per cent. as much purifying material as from the other. I wish to ask if this was at the same time of year, so that the gas was passed at the same rate through the purifiers, and at the same temperature, in both cases.

Mr. Lynn—Yes; they were "two successive consignments."

Mr. Clark—I understand that 12 inches was the size of the center seal Mr. Lynn refers to. Is it not common experience that in large size center seals it is practically impossible to have the joint between the cap and seal tight? If anybody has a center seal as large as 24 inches, and it is tight all the time, I would like to hear from him, for I do not know how he does it. This really has nothing to do with Mr. Lynn's paper, but is a question suggested by his remarks.

Mr. Lynn—This crack was not in the joint, but in the division of the center seal.

Mr. Thompson—No doubt it is difficult to keep a center seal tight where you desire to grind it tight, for the reason that excessive grinding is very likely to wear away the divisions radiating from the center of the seal. We are very careful when we grind our center seals to keep the emery and oil off from those divisions.

On motion of Mr. Dunbar, seconded by Mr. Thompson, the thanks of the Association were voted to Mr. Lynn for his paper.

The Association then adjourned to Thursday, May 16, 1895, at 9:30 A.M.

SECOND DAY—MORNING SESSION.

The Association was called to order pursuant to adjournment, and the President said the proceedings would be commenced by Mr. J. A. Faux, of Pittsburgh, Pa., who read the following paper on

RECUPERATIVE FURNACES AS APPLIED TO BENCH FIRING; THEIR OPERATION AND RESULTS.

Recuperative, tending to recovery or pertaining to recovery; in bench firing, meaning the recovery of waste or lost heat, and returning it either through or above the fire to assist in maintaining the temperature in the fuel or combustion of fuel gas formed in the generator.

Recuperative furnaces are of two kinds, half-depth and full-depth. A half-depth recuperative furnace is one in which the zone of combustion is removed from the beginning of the heat absorbing surfaces by introducing sufficient air pre-heated to a certain temperature, which has a tendency to shorten the flame in the combustion chamber. A full recuperative furnace is one that is greatly enlarged in the principles applied in a half-depth, viz., both in the size of the furnace and the length and number of the recuperative flues. The zone of combustion is much shorter. The furnace has a much deeper fire bed, and the air is sent to the point of combustion heated to a very much higher temperature.

A full recuperative furnace is capable of giving better results than any other furnace used for heating retorts, both in economy of fuel and in maintaining a constant temperature. This furnace is now giving better results than have yet been obtained by any other type.

In starting a recuperative furnace the producer or furnace proper is filled with fuel and lighted. The primary air necessary to maintain incandescence in the fuel enters through the openings in the sides of the ash pit underneath the fire-bars, and is raised to a high temperature by passing it through a series of flues encircling the ash pit. The primary air and steam are mixed in the proper proportions in this flue, and are raised to the same and very high temperature. In a properly constructed recuperative furnace the steam can be superheated with no additional expense by making a series of steam pipes in the recuperative flues. The superheating of the steam is a decided advantage, for the reason that it will then enable the use of the proper amount without the disadvantage of cooling to a great extent the incandescent carbon, and will enrich the gas with its hydrogen and oxidize the coke much more rapidly, thereby reducing the quantity of nitrogen.

The decomposition of the carbon with this superheated steam and primary air produces first $H_2 + CO_2$, then $CO_2 + C = 2CO$. The place in the generator where the larger per cent. of the chemical action takes place is known as the zone of combustion, and from here the gas passes on its way to the nostril holes of the generator and is called producer gas, containing about 50 per cent. of nitrogen. With the use of superheated steam with the heated primary air the initial temperature in the generators can be kept at such a low point that the mineral matter in the fuel will be converted entirely into ash instead of clinker. Under these conditions the rate of combustion is easily controlled, and, with this low temperature in the generators, the life of the same is very much longer, and under the same condition the H_2O and CO_2 are completely converted into hydrogen and carbon monoxide at a low temperature, which results in the saving of fuel as well as reducing the labor of the fireman. At the nostrils the producer gas meets a second supply of superheated air, termed the secondary air, which has been raised to a very high temperature by recuperation. This results in the CO and H being again burned to CO_2 and H_2O, giving a very high flame temperature on account of the initial high temperature of both gases. The chamber where this intense heat is generated is called the combustion chamber, and should be sufficiently large to allow for the expansion of the burned gases. The amount of secondary air should be such that combustion will be complete, and the waste products of combustion should not show over 0.5 per cent. of a free oxygen. The combustion flame will be short and complete. At no time should this flame exceed the height of the combustion chamber; for if it does the unburned portion of the gas is likely to be burned in the flues and chimney, and if good recuperation is not used the heat will all be lost. In any event, the flues and chimney are not the places in which to burn the gases.

In full-depth recuperative furnaces of proper construction the gasifying of the fuel (in connection with other economical features) and the saving of the fuel are much greater than by any other common process of production of heat. By converting the fuel into a gas and using without loss by cooling (as in gas making) we are able to use for heating the retorts an inferior coal, or coke breeze, or both, neither of which could be used in an ordinary fire. In a practically perfect recuperative system we are enabled to obtain a very high heat, and a large quantity of the same, on very economical principles.

Results in retort firing as at present obtained show that in many furnaces much more than one-half of the fuel used is wasted. In our best furnaces at present in general use the amount of fuel used is far in excess of the amount required. In a full-depth recuperative furnace the waste heat can all be returned to the oven, allowing only sufficient to escape with the products of combustion to cause sufficient draught for the proper working of the furnace and keep all water produced by combustion in the form of steam. In the use of bituminous coal for retort firing, immediately after a fresh supply of fuel is laid in the fire, very large amounts of highly valuable heat giving hydrocarbons are produced. The distillation of these is a heat absorbing process, and if their combustion is perfectly accomplished it will add greatly to the efficiency of the producer, as well as to the value of the heating power of the producer gas.

The coal is distilled off faster than thecoke is oxidized, consequently the quality of the gas will vary; under these conditions the perfect control of the proper quantity of air to make the proper length of flame is almost impossible. The dampers and draught should be adjusted to the flame length at the average amount of gas made. With this point carefully studied, and the production of gas and the supply of air for the combustion of the same properly adjusted, the best practical results will be obtained. For a short time, when fresh fuel is charged in the generator, a small jet of superheated steam is turned into the secondary air flues, the amount of secondary air is increased, which, with the steam, completely consumes all excess gas burned from the fresh fuel and allows no smoke to pass into the stack. Bituminous coal has a heat value of 1.038; retort coke 0.866, a difference in favor of the coal of 16.2 per cent. Carbon = 1. A pound of coal will develop about 1,400 more heat units than a pound of coke, for the reason that the coal contains a considerable amount of combined hydrogen, which has a very high thermal value. From this it will be inferred that from bituminous coal firing we are to expect by far the best results, if we are able to properly construct a furnace and setting that will give us the full value of the fuel. From the following we are able to infer what, in the near future, will be the results in practice with a full-depth recuperative furnace in the heating of retorts for gas making. With a low grade of coke made from unwashed slack coal, with ash at about ten per cent., 11 pounds of same in the generators will carbonize 100 pounds of same quality of slack coal. One pound of carbon from gas coke with good combustion will yield 12,632 heat units. Then one pound of slack-coal coke with about 10 per cent. of ash will yield only 11,368 heat units, and 11 pounds will give 11×11,368, or 125,048 heat units.

For the carbonization of good quality of gas coal only 70 per cent. of the above amount of heat is needed, or 87,533 heat units per 100 pounds in the retorts.

A good furnace or generator of the modern full-depth recuperative type can produce from a ton (2000 pounds) of unwashed slack coal about 140,000 cubic feet of producer gas, containing about 40 per cent. of combustible material, having a heat value of 151 heat units per cubic foot, or a total of 21,000,000 heat units. If it requires 87,533 heat units to carbonize 100 pounds of gas coal, then 21,000,000 heat units will carbonize 24,000 pounds, or 8.3 pounds in the generator to each 100 pounds in the retorts.

In the use in the generators of a good quality of coal, in which the per cent. of ash is low, corresponding results will be obtained. These facts are startling when we consider the amount of fuel we are wasting in the many kinds of furnaces in use for retort heating—in most instances as much and more than 25 pounds of fuel for every 100 pounds of coal carbonized.

In a large recuperative furnace, producing practically perfect combustion, results as referred to above can without doubt be obtained. The heat can all be recovered except the small amount needed to keep the products of combustion above steam temperature.

The following are results that have been obtained in ordinary practice with a full-depth recuperative furnace with a bench of 6's and small arch:

For the month of March:

Amount of unwashed slack carb......	1,072,800 pounds.
Amount coke from unwashed slack, used for fuel in generators...............	112,980 pounds.

Or an average of 10.53 in generator to 100 pounds slack carbonized, or an average yield of 3.85 cubic feet per pound.

Used an average of .7 gallons of 65° naphtha per 1,000 cubic feet of mixed gas; total candle value, 19. Allowing 6 candles per gallon, we have 4.2 candles from the naphtha; $19 - 4.2 = 14.8$ candles, or 56.98 candle-feet per 100 pounds slack.

By increasing the fuel in the generator 2 pounds per 100 pounds in the retorts, we are able to increase the yield to 4 cubic feet per pound, or an increase of .15 cubic feet per pound. To this yield we must add .9 gallon 65° naphtha $= 5.4$ candles; 19 candle — 5.4 candle $=$ 13.6 candles per foot, or 54.4 candle-feet per pound.

The above shows that any yield of gas over 3.85 is produced at a loss both of fuel and naphtha. The per cent. (about 18) of combustible in the ash of these furnaces is quite high, which is accounted for in the faulty construction of the first generators. Should the combustible be reduced to about 7 per cent., the difference will materially decrease the present average per 100 pounds in the generator.

It is with reluctance that we accept this as the ultimate result. The plainer and more infallibly certain we are that the result will be attained the more doubtful we seem to be of its occurrence. We must certainly admit that this is a stepping stone, and in practice it will be firmly supported. It is as yet a novelty. It may be possible that some will dare for a time to set their feet upon it, but ultimately they will be found in the tide of general practice. This is an age of improvement, and we as managers are liable to our superiors for our results. Let us be, therefore, alive and awake to their interest, and not stand by and see at least one-half of our fuel going up the chimneys without making any effort to prevent the same. It is now time that we assist in this concentrated tide of improvement, no matter how undesirable the landing may be.

DISCUSSION.

THE PRESIDENT—Mr. Faux will be pleased to answer any questions.

MR. FORSTALL—Mr. Faux says that for the carbonization of a good quality of gas coal 87,533 heat units per 100 pounds are needed. I would like to know where he got that figure. I always thought that, while theoretically it was very hard to ascertain how much heat it takes to carbonize a pound of coal, practically it was still harder.

MR. FAUX—I think the explanation is given in that part of the paper which states that 11 pounds of coke from unwashed slack will carbonize 100 pounds of the same quality of slack coal. It is worked down from that.

MR. FORSTALL—I understood from the statement that that was the amount of heat actually needed to distill the coal, without taking any account of the loss; but if that is the total amount of the heat, then I understand it.

THE SECRETARY—At what temperatures do your waste gases leave the bench?

MR. FAUX—I cannot tell you. I have never tested the temperature, because the stacks are always black or dark. At one time we thought about making the test, but discovered that in order to do it we would have to dig underneath to get at our lowest flue, because, while between the furnace and the stack is only 9 inches, there is no question but that underneath there is a good deal of radiation. It would not be a fair test to take the temperature at the top of the stacks.

MR. HIGHLANDS—I think we have listened to a very able paper, and one that will no doubt lead to good practical results. I move the thanks of the Association be extended to Mr. Faux for his very able paper. (Seconded by Mr. Nash, and adopted.)

Mr. George Osius, of Detroit, Mich., then read his paper, entitled:

AMMONIACAL LIQUOR; WITH A SPECIAL REFERENCE TO THE UNIVERSAL SAVING OF THE SAME BY GAS COMPANIES.

Mr. President and Gentlemen:—The subject, "Ammonia," has become a familiar factor with gas works, large as well as small ones, more during recent years than at the time of primitively constructed gas works producing a poor but high-priced light.

No gas works in these days of progress can afford to stand in the field of competition without the most economical as well as the most efficient equipment for the production of the "light of the people" in its various stages. It is no longer a question how small a plant will you need to make the gas or how cheaply you can erect your plant, but where can you get the most perfect apparatus to make the best gas at the lowest cost.

You are well aware that the success of business depends upon its economic conduct; for matters which may at first appear to us to be insignificant will, in the course of time, grow to importance and become items worthy of attention.

No longer than ten or fifteen years ago bye-products of gas works were waste products, being unavoidable burdens to the gas company and to the inhabitants of cities blessed with a gas works. Year after year conditions have compelled the producer of gas to study its cost most carefully, and, in order to reduce it, to adopt more efficient apparatus and to employ its products to the best possible advantage. All this has had a tendency towards investigation of opportunities for the creation of new revenues or of finding a more profitable market for these products. It is for this reason, and also because of the repeated suggestions of interested parties, that the ammonia, or, as it is better known to you, the ammoniacal liquor, has of late received more attention than heretofore. But still comparatively few works are awake to the fact that thousands of dollars are wasted annually through their inattention to the ammoniacal liquor incidentally produced within their doors.

Continuous agitation and presentation of facts and figures have done much to arouse an interest in this product, especially for the purpose of adding additional revenues to the annual income. While a great many gas works—some of them with but a small output—have adopted during the last five years a process of concentrating their crude ammoniacal liquor, many allow themselves to remain behind the line of progress. Of nearly 1,000 American gas works, only about 150 utilize their gas liquor in some form or another. Some works do not produce any ammonia, but there are hundreds with an aggregate consumption of over four hundred thousand tons of coal per annum that are wasting their ammoniacal liquor resultant from that carbonization. Assuming, as a conservative estimate, that their ammoniacal liquor will not exceed 18 pounds of 20 per cent. NH_3 in the liquor per ton of coal carbonized, we arrive at the surprising amount of 7,200,000 pounds of 20 per cent. NH_3 liquor which is annually lost to this country, and more especially to the gas works.

Ammoniacal liquor is now a staple product on the market, and it must be obtained to supply the wants of the various branches of industry dependent upon the product. In nearly all instances where ammoniacal liquor is used, sulphate of ammonia can be substituted should a shortage of the liquor be caused through an unusal demand, and for that reason the large manufacturing establishments of the country have not been embarrassed as yet concerning whence to draw their supplies.

Are the American gas works the sources of such supplies, and does our own capital produce this source of income to its principal? Oh, no! We prefer to waste millions of pounds annually which could, with little care and expenditure, largely decrease our dependence upon our foreign neighbors; but instead of utilizing whatever quantity of liquor our American gas works produce, we go to foreign markets and bring over thousands of tons of ammonia in various forms, while millions of pounds are wasted at our doors.

Two questions will naturally be asked: First, how will it pay us to utilize the crude ammoniacal liquor? Secondly, if all gas works would save and sell the liquor, would this not have a tendency to create an over-production and therefore reduce its value below a reasonable basis of profit?

In replying, I will more especially refer to gas works carbonizing from 750 to 3,500 tons of coal per annum, as most companies with a larger consumption have seen the advantage before this of giving the ammoniacal liquor proper attention..

In computing the pecuniary advantage of this investment, expectations should be built upon a basis which would apply to ordinary investments and upon which a corporation would be prepared to enlarge its works—in other words, to expect a fair and reasonable return from a permanent expenditure connected with the undertaking. An investment in the commercial world, yielding its principal 15 per cent. per annum and more, I may say is considered a desirable opportunity. Why, then, should the utilization of ammoniacal liquor be considered differently? Is it not worth while to reduce the general cost of gas a few cents per 1,000 feet without even entailing expenses other than the first investment? The years have gone by when the profits of gas companies would soon equal the cost of the fundamental investment; and it is to-day the small savings at this and that end of the works which help swell the amount to be earned for a dividend. Wherever the ammoniacal liquor is saved, as a matter of consequence other savings are made which increase directly and indirectly the benefits from the investment. In giving proper attention to the saving of all the liquor produced, the liquor must be subjected to a thorough settling, and it is thus relieved of a considerable quantity of tar which would be carried away with it into the sewer, providing the liquor were not saved. This saving, small as it may appear, increases the accumulation of tar by at least 10 per cent., and, estimating this at $1.50 per barrel, is this not worth saving? This result should be added to the profits stated before.

Again, you derive indirect benefits. The method of saving the crude liquor compels you to use the weak liquor for the washing of the gas, and you are therefore in a position to extract almost all ammonia at the scrubber, instead of allowing the purifiers to take care of it. Your purifying material will be allowed to serve longer, less time is required to change the foul boxes, and your expense account as well as your gas receives the benefits.

To attain all these results you will not be called upon to increase your pay roll or incur other expenditures, save that of the cost of the concentrating plant; and, as the latter can be obtained on most convenient terms as regards the method of payment, there is no reason why your attention to the question should be put aside—because of a possible doubt that the undertaking will not pay. Give the washing of the gas reasonable attention, let a scrubber of sufficient capacity (not the boxes) eliminate the ammonia from the gas; save the liquor from all sources; prevent the escape of ammonia gas from defective storage tanks—and you cannot fail of success; and at the end of the year the pecuniary results will be most gratifying. If these suggestions are carried out, it will prove to you that, even on a small carbonization, your efforts will be not only well rewarded, but that the money invested has earned you without doubt from 15 to 75 per cent.

The second question, not less important than the first, can be answered by an explanation of general conditions in this country pertaining to ammonia.

The steadily advancing improvement of refrigerating machines has caused an almost universal use for them on land and sea, thereby constantly increasing the demand for ammonia, the only refrigerating agent used to any extent. Thousands of farms depend, from year to year, upon sulphate of ammonia as an artificial fertilizer. A number of old and new branches of American industries depend upon ammonia as an important raw material in one form or another. Neither of these channels will ever cease to be an outlet, and more ammonia than now produced will be required in the future. The adoption of the water gas process by a large number of our gas works as an auxiliary to their plant, and the abandoning of the coal process entirely at some places, have, during the last 5 or 10 years, decreased the domestic resources of ammonia. During the last two years, over 26,000.000 pounds of ammonia in various forms were imported by the United States. While this may seem an unusually heavy importation, there is no doubt that Europe will always supply us with a portion of our requirements. As you all know, efforts are being made, with all prospects of an early success, to introduce the various systems of coke ovens in America for the purpose of utilizing the by-products, and especially the ammonia resultant from the process. While we may expect with certainty large quantities of ammonia in the liquor as well as in the salt from this new source, you can safely assume that any increase in our home production will either be taken care of by a larger demand or will decrease the importation. However, as the increasing demand for refined ammonia will steadily keep pace with the production of the raw material, I see no danger of an over-production in this country, notwithstanding a reasonable importation of the article from foreign countries.

I therefore recommend to you the saving of your ammoniacal liquor, which is not only a source of remunerative and additional income, but is also in line with the principle of economy.

DISCUSSION.

THE PRESIDENT—I think this is a very interesting paper, and Mr. Osius will be only too pleased to answer any questions.

MR. OSIUS—I may state here that, in addition to the data given in this paper, I have some which, owing to an accident, I was not able to put my hand on at the time of writing. The production of sulphate of ammonia in the United States is 30 million pounds; that is, our entire product is 30 million pounds, irrespective of the ammoniacal liquor; and as this is about all used in this country for fertilizing purposes only, we have a large amount to supply for mercantile, mechanical and other purposes, whatever they may be. So you see that it is almost impossible to cause an over production in this country, or a production beyond what is needed for domestic uses.

MR. HOWARD—With the minimum amount of coal carbonized, would it pay to put in a plant for saving the ammoniacal liquor?

MR. OSIUS—I believe it would. Although the return may in some cases seem very small, comparing with the amount of money which it is necessary to invest, still I think it would pay to erect a plant for even the minimum amount of coal carbonized, as stated in my paper. If you get 18 pounds of 20 per cent. liquor per ton of coal carbonized (which is the lowest estimate I have accepted in my paper), your investment will certainly pay from 15 per cent. up, counting as well the interest which you would necessarily have to figure on your investment of capital. Of course it would depend somewhat upon the price you would be able to obtain for your product. But, as I stated before, no one with a small carbonization, taking up this question and looking into the matter, should expect a gold mine. It will return a fair percentage on the investment, such as you would be willing to make every day—a fair and safe investment. Of course, the larger the carbonization, the better would prove the investment A small carbonization, say of 750 tons of coal per annum, would realize, say, from 15 per cent. upward.

MR. HIGHLANDS—This is one of the papers that we can take home, and from it study and figure out for ourselves the results and benefits to be gained from it. I do not think there are any here who are operating a coal gas plant who will not be able to derive satisfactory pecuniary benefits from the investments which Mr. Osius has suggested. I therefore move a vote of thanks to Mr. Osius for his very interesting paper. (Seconded by Mr. Howard, and adopted.)

In the absence of Mr. C. B. Case, of Milwaukee, Wis., the President asked Mr. E. G. Cowdery to read the paper by the former on

THE BEST METHOD OF INTRODUCING GAS ENGINES.

While called upon to tell you the best method of introducing gas engines, I prefer to tell you what we have done in Milwaukee to this end, and with what result, and leave you to decide whether or not ours is the best method.

In November, 1893, the Milwaukee Gas Light Company decided that 47 gas engines were not a sufficient number for the thirteenth city in population in the United States, and employed the writer to take hold of the matter of increasing the number of users of gas engines in that city.

My time was originally divided between the gas engine industry and the sale of tar and coke; but in June, 1894, the gas engine end of the business warranting the change, and proving more congenial to me, a division of labor was effected whereby the gas engines solely came under my charge.

To start with, I didn't know a gas engine from a threshing machine. I was possessed of some newspaper experience, and had for 12 years been a traveling salesman in lines quite foreign to this. Investigation, however, made me an enthusiast on gas engine economies. I made it my first work as a representative of the Gas Company to visit personally every user of a gas engine, and ask information as to the satisfaction each engine was giving, make and horse power of each, class of work being done, average hours and load, and such other matters as circumstances might suggest. This was tabulated, and, with the gas bills for every engine in use in 1893, was printed in book form under the title of "Gas for Power," and distributed freely to all power users in the city in the early spring of 1894.

Meanwhile the Gas Company secured the local agency for such gas engines as were generally considered the best, where they had no other local agent, and gave their selling into my hands. We sold the engines as nearly as possible at their regular selling price, the commission received readily offsetting the attendant expense and salary of the department.

Several sales resulted directly after our book was circulated, and inquiries for facts and prices came throughout the summer. In September our Industrial Exposition opened for a month, and we had consigned to us without sale a 12-horse power engine, which we attached to a dynamo and gave an electric exhibit furnished by gas engine power. This was an eye-opener to many, and we gave away personally 10,000 copies of a "Gas Engine Primer," got up as a souvenir for this occasion. Commencing in September, we also continued our educational campaign through the newspapers, by means of write-ups and display advertisements, the artist invariably using some fresh cut to attract attention to what we had to say in print—a few words to the point. The classified or want columns of our daily press we also used to advantage continuously for several months, changing copy each week, which kept our reminders always in print. This was accompanied, of course, by personal solicitation among steam and electric power users, and the largest users of electric light. The result of this educational campaign has been satisfactory in many ways. We have not only increased the number of users of gas engines 30 per cent. the first year, but we have put ourselves where we are recognized as a factor when power is thought of. I can now get an audience with anyone, while formerly the words "gas engine" were received as something of a joke, and dismissed with the conviction of pre-eminence in the assurance that "we use steam power," which was supposed to settle us.

While personal solicitation is essential to success in this as in any other pursuit, there is also something more that is especially needed in the gas engine business, and that is the establishing of a moral tone with the public, favorable to gas engine power. The gas engine is right, and does not need to be defended; but the public will not find it out unless they are told. Every way in which gas engine figures and facts can be put into the minds of the public, whether through their eyes or their ears, is a gain on the side of gas for power. The indirect results are not to be despised, and the establishing of a popular feeling generally is very essential. We have learned in Milwaukee also to aim for the big game, the users of 50-horse, 100-horse, and larger horse power, not despising the smaller ones, but trusting them to follow the lead of the larger, rather than to the larger following the smaller. The old idea that gas engines are only suitable where very small power is needed is now easily combated and overthrown.

In January of the present year we again printed the past year's gas bills, adding the new names and some new facts, and distributed them, together with a blank to be filled out by steam engine users as to the cost of operating their plant, and asking for comparison with the same sized plant operated by gas engine power. The sale of three engines in two days followed this, and other sales later, among them a 50-horse power; about two inquiries a day for prices and facts have succeeded, and the outlook for spring business is most promising.

We obtained 20 new users of gas engines during 1894, aggregating 148 horse power, and lost 6 for reasons nowise to the discredit of gas engine power. Where we had 47 engines in use in the city in January, 1894, we have 61 on January 1, 1895—a 30 per cent. increase.

I recognize the fact that circumstances are not the same with all of you as with us in Milwaukee. Before taking hold of this business myself there were but two or three dormant agencies in our city, where, if a man was determined to buy a gas engine, he could be accommodated; but there was no one to tell the story in all its truth. In many of your cities the best engine factories are doubtless already represented. If not, your course is clear. Secure the agency of one or more of the best engines, either as an adjunct of the State agent, or direct from the factory, and turn a good man loose in the community to tell the truth. Get a man rather than a boy, one who, seeing merit, can tell what he sees and believes. Adopt a liberal policy; expect to spend a few dollars in printers' ink, and pay your man a living salary rather than a commission on the sales that may be (doubtless will be) remote. He may possibly go some months without effecting a sale, but if he is the right man he is educating both himself and the public while making the effort, and the desired results must follow as a consequence.

If, on the other hand, your city is properly represented by the best gas engine factories, get close to each agent by inviting him to your office and talking the situation over. Without prying into their business, get at the situation from the standpoint of each, and many ways of holding up their hands to your advantage will appear to you. If it seems warrantable, let one of your best office men devote part of his time to the gas engine business in the way of assisting the resident agents in telling the truth to unbelievers. Without singling out any certain engine, you can still use printer's ink to put the benefits of gas engines in general before the reading public. Print the amount of the gas bills for the different engines, and put it into every man's hand.

We in no manner allow ourselves to antagonize any good make of gas engine offered in our city, although we have our preferences, and our reasons for them are justified by economy in gas bills and freedom from repairs, etc. We don't sell all the gas engines sold in Milwaukee, but we still take the credit of creating the demand largely. We do not sell our engines at cost, nor do we think it would be appreciated by the purchaser if we did, and certainly not by the factories. We do pay freight and cartage usually, making our price net delivered on their foundations. We have also inaugurated a time payment and lease system of sale which is captivating to firms of moderate means, and sometimes to the larger ones. The risk is reduced largely by the leasing plan, as the property remains ours until paid for. We require a moderate first payment, and the balance monthly to suit, small interest being added.

There is one thing still in line for each Gas Association and each individual gas company to do, and that is to hammer at the gas engine makers to reduce their selling price. A steam engine of the highest grade does not cost over 10 cents per pound to-day, and there is no satisfactory reason to be given why a gas engine should cost two or three times as much per pound. It is true that gas engine factories are working overtime and are behind on orders, and such a condition is not favorable to reducing prices. But the fact remains that a 25 per cent. cut on the present list price would double the sales and leave a good profit to the makers as well. The gas engine business is destined to grow to as great proportions in this country as in foreign countries, and the best makers should be the first to advance to the plan of fair prices, enlarging their plants and their output to hasten that day, and not stand in their own light by adopting the policy of getting all they can for the engines they do make, at the expense of their own pocket and yours. Gas engines will in a few years sell themselves if the makers will supplement the efforts of the awakened gas promoters by an approach to civilized prices.

Meanwhile you can tell the truth about gas engines, and use the printer to help you, and a public hungering for economies will get in line at your application window asking for meter and service to gas engines.

DISCUSSION.

THE PRESIDENT—I know Mr. Cowdery is able and hope he is willing to answer any questions on the subject of this paper.

THE SECRETARY—What is the power of the smallest size of gas engine now in use in Milwaukee?

MR. COWDERY—Four-horse power.

MR. PETER YOUNG—Can Mr. Cowdery tell us in what places and for what purposes these gas engines were generally placed and used?

MR. COWDERY—For printing offices, for elevator work, for small machine shops, and some in carpenter shops. I think that covers the ground. I cannot think of all the different uses readily. I think that several are used in electric light work.

THE SECRETARY—When a 10-horse power Otto engine is put on the second or third floor of a building, what means do you adopt to prevent its shaking the building or floor?

MR. COWDERY—I do not know that we adopt any means. We have had no great trouble from that source. In one or two cases that I know of, a battery of four engines was put as high as the fourth floor of a building, and while standing on that floor a decided vibration of the floor was noticeable. On the floor below it the vibration could be felt a little, but otherwise it did not seem to trouble the occupants of the building at all.

MR. JENKINS—Last season we put a 16-horse power gas engine on the third floor in the corner of a building. We ran iron stanchions from the basement to that floor, and then arched over with iron and brick, thus making a solid foundation for the engine to rest on.

There is a slight vibration on the top floor—you would not notice it when standing on the roof—and it was not sufficient to interfere at all with the building.

Mr. J. W. Stratton—Did your gas engines displace any electric motors?

Mr. Cowdery—Yes: quite a large number, especially the engines put up last year. Several parties who formerly used gas engines, and had thrown them out and put in electric motors, came back again to gas engines on account of the high cost of electric power. The general impression gained by us from a number of people we talked with was that the electric power cost about three times that of gas power.

Mr. Thompson—I am sure we have all listened to a very instructive paper, which will be of very great value to us in pushing our local gas engine business. I move a very hearty vote of thanks to Mr. Case for his very valuable paper, and to Mr. Cowdery for the information he has given us in connection therewith. (Carried.)

SOME FURTHER DISCUSSION OF THE PAPER BY MR. OSIUS.

The President—I have been informed that there are members present who would like to ask Mr. Osius some further questions regarding his paper on "Ammoniacal Liquor." Are there any questions that any one desires to ask Mr. Osius?

Mr. Somerville—I think the debate on this most important paper by Mr. Osius was cut off rather short. In view of the fact that the manufacture of gas from coal is likely to increase rather than diminish, I think the discussion of this paper ought not to have been shut down in the way it was done. I do not know that I have anything to add to that discussion: but I know there are a number of people here who are concentrating their liquor, and I would like to hear from them if they are willing to corroborate Mr. Osius' statements. A word from those who are using up their liquor will, I am sure, go a greater way to convince those who are thinking of trying it than the statement that Mr. Osius himself makes. I believe Mr. Forbes is trying to do just what Mr. Osius recommends, and so would like to hear something from him, to the end that we can understand whether the experience of each is measurably alike. It is to me a most marvelous thing to think of the amount of valuable ammoniacal liquor that runs to waste. At Indianapolis we get 40 cents per ton of coal carbonized for our ammonia. If some of the other companies get half that amount, then there is that much saved. I can corroborate his remark about extracting the tar at the scrubber rather than allowing the purifiers to take care of it. A saving is made in that way: and not only that, but bringing the gas in contact with the liquor itself saves at least 25 per cent. Taking it altogether, I think we ought to make more from our ammoniacal liquor than some of us do at present.

The President—Do you estimate your ton of coal at 2,000, or 2,240 pounds?

Mr. Somerville—Our ton of coal is of the weight of 2,000 pounds.

Mr. Forbes—I do not know that I have much to say except to corroborate what Mr. Osius has read. We have been working off the liquor for perhaps two months, but the result has been very satisfactory thus far, and more especially in respect to the gas. The effect on the gas has been of importance and value to us since we have been working with the weak liquor; and the returns from the concentrated liquor have been more than satisfactory. Mr. Peter Young would know more about that, for he has been longer at it than I have.

The President—We would like to hear Mr. Young's experience in concentrating ammoniacal liquor.

Mr. Peter Young—We have been concentrating our liquor for only a very short time, and have made but one shipment of it, but so far we have found it very satisfactory. That first shipment returned us about 3 cents per 1,000 feet of gas made. The process is working nicely now, although we had some trouble at first. Our coal in the South seems to be a little different from the Youghiogheny coal in that ours carries a little more sulphur. As we had no acid testing apparatus, we had to depend upon the hydrometer, and there being such a large percentage of sulphur in the coal, the specific gravity of the liquor was so increased that we were very much disappointed when we came to make the acid test. After finding that out we got along very well, and the result has been very satisfactory.

Mr. Osius—May I be allowed to say another word in reference to this question? It has frequently come to my notice that the ammoniacal liquor had been satisfactorily concentrated by this or by that process—that a strong liquor has been produced and a satisfactory result obtained per ton of coal carbonized—still, when the liquor was shipped it proved to be considerable less than estimated, sometimes one-half and sometimes only one-third. I take the opportunity in this connection to specially call attention to the practice of storage. It is the most important detail, I think, in this whole matter. I have known of instances where a satisfactory amount of ammonia was produced in concentration, but the storage tank lost it afterwards. Ammonia is extremely volatile, and particular care must be taken to keep the concentrated product in a perfectly tight place, for thus only can you get satisfactory returns and have satisfactory results.

Mr. Clark—I was so unfortunate as not to hear the discussion of Mr. Osius' paper, and I would like to ask if there has been any recent experience in connection with the liming of coal for increasing the ammonia. A number of years ago I made several experiments in that line, and while I am still thoroughly satisfied (having a full share of self confidence, perhaps) as to what the results will be of coal liming, and as to its value, I have not yet been able to get anybody in America to express the same opinion. Possibly in the last two years some one has had some experience which may be valuable to me in this connection.

[illegible] Osius makes it clear when he states
[illegible] be derived from putting in a plant
[illegible] will be from 15 to 75 per cent. on
[illegible] wide variation. Mr. Knight. of
[illegible] plant was put in for him at an ex-
[illegible] revenue therefrom is $19 per month.
[illegible] I wish to ask if that is about the
[illegible]?

[illegible] be taken into consideration is based.
[illegible] and. second. upon the price for the
[illegible] from the market cannot expect the
[illegible] close to it: and there are other circum-
[illegible] will influence the pecuniary results. I
[illegible] said before—that on a carbonization of
[illegible] be estimated at 15 per cent. under
[illegible] the party is careful and observant enough
[illegible] after he has once saved and concentrated
[illegible] the storage tank. In most cases the weak
[illegible] same as in respect to buying coal. Two
[illegible] weight of coal that is of the same quality.
[illegible] less satisfactory than that of your neigh-
[illegible] and still you use the same coal. You may
[illegible] than your neighbor. or one may have
[illegible] than the other. Such varying conditions will
[illegible] same proportion the results derived from
[illegible] liquor. I hardly think that the results ob-
[illegible] plant should be taken as a fair basis for an
[illegible] is present I would be very glad to meet him
[illegible]

[illegible] Mr. Osius urges the necessity of having tight
[illegible] like to know how it is that. when in shipping
[illegible] compelled to ship in a Union Tank Line car.
[illegible] and with pipes not very tight—we find in
[illegible] ounce short?

[illegible] discrepancy of only one ounce on a strength of 40,
[illegible] indeed. especially when you consider the dis-
[illegible] has to travel before reaching its destination. You
[illegible] that much in pumping to the car. or before you
[illegible] sealing the car or screwing up the lid. So I be-
[illegible] the smallest loss you should consider. In the
[illegible] will be fortunate if it is not more than that. Of
[illegible] should be as tight as the storage tank. since it is at
[illegible] the influence of sun and weather.

[illegible] I would like to ask Mr. Osius this question: One ton
[illegible] would neutralize how many ounces of sulphu-

MR. OSIUS—Do you mean to ask how much 1 ton of 100 per cent. liquor would require of acid to neutralize it? That would be 1 ton of 400-ounce liquor, if I understand your question rightly. Of course it is an impossibility, under any conditions, to have a 100 per cent. liquor.

MR. THWING—Containing 20 per cent. of ammonia in concentrated liquor.

MR. OSIUS—One ton of 20 per cent. liquor is equal to one ton of 80-ounce liquor. Of course you are familiar with the manner of testing, and understand what the expression implies.

The Secretary then called the roll, the following members responding:

ROLL CALL.

Honorary Members.

Slater, A. B., Providence, R. I.
White, W. H., New York City.
Leach, H. B., Taunton, Mass.
Barker, F. E., Boston, Mass.

Active Members.

Baxter, I. C., Detroit, Mich.
Bivings, W. L., Birmingham, Ala.
Blodget, C.W., Brooklyn, N.Y.
Butterworth, Irvin, Columbus, O.
Byron, T., Birmingham, Ala.
Chollar, B. E., St. Louis, Mo.
Christie, W. H., Corning, N.Y.
Clark, W., Philadelphia, Pa.
Collins, C., Green Bay, Wis.
Corscot, J., Madison, Wis.
Cowdery, E. G., Milwaukee, Wis.
Cowdery, R. E., Topeka, Kas.
Cressler, A. D., Fort Wayne, Ind.
Darrah, S. M., Wheeling, W. Va.
Dunbar, J. W., New Albany, Ind.
Dixon, J. A., New York City.
Eaton, W. M., Jackson, Mich.
Elbert, V. L., Menominee, Mich.
Evans, C. H., Chicago, Ills.
Faux, J. A., Pittsburgh, Pa.
Ferrier, J., Columbus, Ga.
Forbes, J., Chattanooga, Tenn.
Forstall, A. E., Newark, N. J.
Greenough, M. S., Cleveland, O.
Gwynn, J., Steubenville, Ohio.
Harper, G. H., Altoona, Pa.
Highlands, S. M., Clinton, Iowa.
Howard, J. B., Galena, Ills.
Humphreys, A. C., N. Y. City.
Hyde, E. A., Ravenna, Ohio.
Jenkins, E. H., Columbus, Ga.
Knight, C. S., Fort Wayne, Ind.
Knight, J. J., Kalamazoo, Mich.
Lansden, T. G., St. Louis, Mo.
Littleton, A. W., Quincy, Ills.
Lynn, J. T., Detroit, Mich.
McDonald, W., Albany, N.Y.
Miller, A. S., L. I. City, N.Y.
Miller, C. R., Pittsburgh, Pa.
Miller, T. D., Dallas, Tex.
Morrell, E. E., Cicero, Ills.
Montgomery, J., Sedalia, Mo.
Morgans, W. H., Pontiac, Mich.
Moses, F. D., Chicago, Ills.
Murdock, J. W., Ottawa, Ills.
Nash, A. F., Windsor, Ont.
Odiorne, W. H., Springfield, Ills.
Penn, J., Washington C. H., O.
Perkins, B. W., South Bend, Ind.
Ramsdell, G. G., Philadelphia, Pa.
Ridgely, E., Springfield, Ills.
Sellers, W. B., Covington, Ky.
Shelton, F. H., Philadelphia, Pa.
Slater, A. B., Jr., Providence, R.I.
Somerville, J., Indianapolis, Ind.
Steinwedell, W., Quincy, Ills.

Stratton, J. W., Valparaiso, Ind.
Taylor, G. H., Warren, Ohio.
Thompson, G. T., St. Louis, Mo.
Thwing, O. O., Milwaukee, Wis.
Tracy, W., Leavenworth, Kas.
Warmington, D. R., Cleveland, O.
Woods, G. E., New York City.
Young, J., Allegheny City, Pa.
Young, P., Knoxville, Tenn.
Young, R., Allegheny, Pa.

Associate Members.

Bissell, W. G., Chicago, Ills.
Bredel, F., Milwaukee, Wis.
Brown, E. C., New York City.
Callender, E. P., New York City.
Dell, J., St. Louis, Mo.
Dickey, C. H., Baltimore, Md.
Goodwin, W. W., Philadelphia, Pa.
Guldlin, O. N., Fort Wayne, Ind.
Harper, H. D., Chicago, Ills.
Harris, J. A., Philadelphia, Pa.
Hauk, C. D., Philadelphia, Pa.
Hayward, S. F., New York City.
Helme, W. E., Philadelphia, Pa.
Hinman, C. W., Boston, Mass.
Higgins, C. M., New York City.
McIlhenny, J., Philadelphia, Pa.
Osius, G., Detroit, Mich.
Page, A. L., New York City,
Payne, F. H., Erie, Pa.
Persons, F. R., New York City.
Roots, D. T., Connersville, Ind.
Roper, G. D., Rockford, Ills.
Russell, D. R., St. Louis, Mo.
Stacey, J. E., Cincinnati, Ohio.
Stout, J., Chicago, Ills.
Stratton, S. S., Erie, Pa.
Taber, R. B., Boston, Mass.
Van Wie, E. G., Detroit, Mich.
Wickham, L., St. Louis, Mo.
Young, A. W., Pittsburgh, Pa.

SECOND DAY—MORNING SESSION.

REPORT OF COMMITTEE ON NOMINATION OF OFFICERS.

Mr. J. B. Howard, from the Committee on Nomination of Officers, reported the following-named gentlemen to hold office for the terms designated by the laws governing the Association:

President—A. W. Littleton, Quincy, Ills.

First Vice-President—W. H. Odiorne, Springfield, Ills.

Second Vice-President—S. M. Highlands, Clinton, Iowa.

Secretary and Treasurer—J. W. Dunbar, New Albany, Ind.

Board of Directors—Wm. McDonald,* Geo. T. Thompson,* Irvin Butterworth,* Wm. M. Eaton,* Geo. H. Harper, Peter Young, O. O. Thwing and Wm. Steinwedell.

ELECTION OF OFFICERS.

On motion of Mr. E. H. Jenkins the report was adopted, and Mr. J. B. Howard was instructed to cast the ballot of the Association in favor of the election of the nominees. Mr. Howard having reported the unanimous election of the gentlemen named, the Chairman called upon the President-elect (Mr. Littleton) to say a word or two. Mr. Littleton responded as follows:

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*To serve for one year.

Mr. President and Gentlemen: It is simply impossible for me to tell you how deeply I appreciate the honor you have conferred upon me in electing me President of this Association. I greatly question the wisdom of your choice, but since it *is* your choice, I can only say that I accept the office—although very reluctantly, and with many misgivings as to my fitness for the place; but I shall certainly try to perform the duties thereof to the very best of my ability. (Applause.)

ELECTION OF NEW MEMBERS.

Mr. William McDonald, on behalf of Committee on Applications for Membership, recommended the following-named gentlemen as eligible for membership in the Association:

Active.

Addicks, W. R., Boston, Mass.
Blinks, W. M., Michigan City, Ind.
Byers, C. A., Haverford, Pa.
Jones, T. C., Delaware, Ohio.
Kuehn, J. L., York, Pa.
Lane, F. K., Chicago, Ills.
McAdams, B., Michigan City, Ind.
McIlhenny, J.D., Philadelphia, Pa.
Seamon, J. F., Uniontown, Pa.
Whysall, G. H., Dayton, Ohio.

Associate.

Collins, D. J., Chicago, Ills.
Ellsworth, F. O., Chicago, Ills.
Henderson, E.H., Pittsburgh, Pa.
Kirby, H. C., Cleveland, Ohio.
Macfarlane, G., Louisville, Ky.
Mansur, J. H., Royersford, Pa.
Mordue, T. N., New York City.
Slocum, F. L., Pittsburgh, Pa.
Whirl, J. J., Chicago, Ills.
Woods, S., Pittsburgh, Pa.

On motion of Mr. Gwynn the report of the Committee was accepted, and Mr. McDonald was instructed to cast the ballot of the Association for the election of the applicants. He did so, and when they were declared duly elected to membership, those present arose and were introduced by the President to the Association.

NAMING THE PLACE OF NEXT MEETING.

The President—Next in order will be the report of the Committee on Place of Next Meeting, of which Mr. Cowdery is Chairman.

Mr. Cowdery—Your Committee have had much difficulty in coming to a conclusion, for we realized there was a desire among the members to go to some new place, with a decided leaning toward the naming of some Southern city. The field was canvassed quite thoroughly, and the claims of Indianapolis, St. Louis, Minneapolis, Nashville, Chattanooga, New Orleans and Atlanta were carefully considered. After covering the ground very thoroughly as to location, facilities for transportation, hotel accommodations, etc., the Committee concluded, in order to meet the wishes of all the members, to recommend to the Association the selection of either Chattanooga, Tenn., or St. Louis, Mo.

Mr. Lansden moved that the Association name St. Louis, and Mr. Thompson seconded it.

Mr. Clark—I move to amend by substituting Chattanooga for St. Louis: seconded by Mr. Miller. The President then announced that the amendment was open for discussion.

Mr. Shelton—I think a trip South would be most enjoyable by this Association. We have met many times in St. Louis, in one capacity and another, either with the American or Western Association. Knowing, as we do, the hospitality of St. Louis, I need not add a word on that point, for we know that we will be royally taken care of if we go to that city; but, at the same time, we are rather given to going over a certain line—circulating between Chicago, St. Louis and Cincinnati—very regularly. I think every man who attended the Savannah meeting of the American Association, in the fall of 1890, will remember the pleasure and the novelty enjoyed in going through a country somewhat new to us. I think Chattanooga is not so far off but that a very fair attendance could be had at that point. Many attractions are to be found there, and there will be a great many matters of interest connected with meeting in a city out of the usual line. I have no doubt the gentlemen in that place would give us a hearty welcome. I would like to hear further discussion and further advocacy of meeting in Chattanooga. I should think the hotel accommodations there would be reasonably good; but I would be very well satisfied to leave that with the Committee of Arrangements. I hope we may have a full discussion of the matter.

Mr. Lansden—The name of our society is the Western Gas Association. We see and rejoice at the number we have here who never were West. They come this far, and believe they are in the West on coming to Pittsburgh. This Association has not had a meeting in St. Louis for seven years; and, therefore, to a large element of our Society St. Louis is almost unknown. As far as my personal feelings are concerned, I would prefer going to Chattanooga; but I am desirous of doing what is for the best interest of the Western Association. I think one great benefit we have is to at least have most of our menbers meet with us once in every two or three years. A certain representation of the small works of the West cannot get away if they have no excuse to go; and if they go they have to pay their own expenses. When we meet in large cities such as Chicago, St. Louis, or Cincinnati, the superintendents of small works can often have an excuse for going, when perhaps their Directors would not let them go under any other circumstances. They can go there to make purchases or to look after machinery. I think it is to the interest of this Association to go West next year—or comparatively West—for St. Louis is really East.

Mr. Clark—I understand thoroughly that the name of this Association is the "Western" Gas Association; but still I was considered eligible for membership therein when I lived in New Orleans, and Chattanooga is nearer St. Louis than New Orleans is. There are many members from the South who are entitled, it seems to me, to have the meetings occasionally come nearer to them. I do not know what the hotel accommodations at Chattanooga may be, but I know that they cannot be worse than they were at St. Louis headquarters the last time the Association met there. The city of Chattanooga, and the country all around it as well, cannot fail to interest you. Not only is it a very beautiful country, but it is a region of great historic interest. Mr. Lansden is in error as to the last time this Association met in St. Louis. We were there in 1890. There seems to me every reason why we should now go to Chattanooga—if the hotel accommodations are all right, and I understand they are, but would not be sure on that point; probably there are some here who do know about that. There is no special reason for going to St. Louis, except that St. Louis gas men have always treated us admirably.

MR. COWDERY—Your committee inquired as to the hotel accommodations at Chattanooga and learned that they were ample to take care of this Association. The hotel on Lookout Mountain has about 500 rooms, and with that number could easily take care of this Association. The hotel is well run, and no doubt would meet all our requirements. It is located on the top of Lookout Mountain, about two miles in a straight line from Chattanooga, or about seven miles by the railroad. Trains run up the mountain regularly and at short intervals, so that those who want city entertainments can easily reach the city, and go back and forth readily whenever they wish.

THE PRESIDENT—We would like to hear from Mr. Forbes, of Chattanooga.

MR. FORBES—I am afraid the hotel accommodations are not sufficient. The hotel is on top of the mountain, and too far from the town.

The President put the question on the amendment and declared it carried.

MR. JENKINS—I think we ought to say to Mr. Forbes, and his Company, that we are going to Chattanooga on our own responsibility. I can understand Mr. Forbes' position very thoroughly; and we want it understood that in going to Chattanooga we go without any invitation, and that we shall expect to take care of ourselves. (Applause.)

THE PRESIDENT—That is the understanding of all the members, I believe.

MR. SHELTON—I understand that the best hotel there is on top of Lookout Mountain, and I would suggest that that would be the most attractive place for the meeting. There is no absolute reason why we should hold our conventions in a city as long as we have accommodations for sleeping and eating and a good meeting room. It seems to me, if we can meet our needs in such respects on top of the mountain, in that warmer section and time of year, the hotel on top of Lookout Mountain would make a most delightful place for the meeting. I suggest that the Committee of Arrangements be instructed to very carefully consider that hotel in selecting the place for the meeting.

Mr. Miller—I would suggest, if you go up there in May, you will see to it that you take your overcoats along.

REPORT OF COMMITTEE ON FEDERATION.

The President—Is the Committee on Federation ready to report?

Mr. Ramsdell, of the Committee, read the following report, which was, on motion of Mr. Jenkins, adopted:

Pittsburgh, May 15, 1895.

To the Western Gas Association: Gentlemen—Your Committee, to whom the subject of Federation was referred, beg leave to submit the following report:

1. The American Association (with whom the matter originated), at its meeting in Washington, October last, by a negative vote stamped it with its disapproval.

2. Your Committee consider the tendency of the times in the gas world to be in the contrary direction. The remarkable display of vicious legislation in many States during the present year seems to demand local combination such as State Associations or State Gas Commissions in order to effectually combat the various forms of pernicious politics.

3. A careful examination of the records fails to show that any Association thus far has indorsed this matter with its approval, or by its vote expressed a desire that a federation be formed.

4. Your Committee, therefore, conclude that, in its present form and at the present time, the subject of federation, while having many good features, is still impracticable; and we, therefore, respectfully recommend that further consideration of the subject of federation be indefinitely postponed. Respectfully submitted,

Geo. G. Ramsdell,
A. W. Littleton,
B. E. Chollar,
Committee.

The President—We will now listen to the paper by Mr. D. J. Collins, of Chicago, on

THE STORAGE AND HANDLING OF OILS IN A GAS WORKS.

The rapid growth of water gas, and the limited use of other processes, which require oil in their manufacture, necessitating its storage in proper manner and considerable quantities, make the consideration of this question of much importance to those interested in the practical management of gas works. Many conditions must be taken into account. It is the aim of this paper to treat them only in a general manner, with the idea of gathering together and possibly suggesting the major portion of desirable or essential points to be borne in mind by those who are likely to become users of oil, as well as those who are already interested. The paper read by Mr. W. E. McKay at the New England Association of Gas Engineers, in Boston, February 21, 1894, so ably and fully covers the construction proper of oil tanks and the measurements proper of oil, that I think it needless to go over such part of the subject again. A general disclaimer herein is made of all tables and equations, for, without decrying the value of such one particle, the object of this paper is rather to cover what are commonly called the "practical" points that are first thought of by those who contemplate the use of oils in gas making. Mr. McKay's paper, an excellent one, in its purpose is more especially applicable to the larger companies. This paper is more for the smaller and medium sized companies.

Crude Oil and Naphtha.—Whether crude oil or naphtha is used, the same consideration and precautions should prevail, for while there is undoubtedy less danger in working crude oil than with the more volatile naphtha, and less current loss by evaporation, etc., crude oil in bulk is nevertheless a highly inflammable substance, requiring due precaution regularly maintained to secure practical safety. As the two materials (crude oil and naphtha) give about the same results in economy in the better class of apparatus, and are used largely and indiscriminately by gas companies according to which is offered the cheapest, they will in this paper be considered, as far as handling, etc., goes, as simply "oils," the points made applying in the main to either one.

TANKS.—*Form.*—The first question which arises is the best form of tank to be adopted. This depends largely on the size of the works, the nature of the ground where the tank is to be located, the climatic conditions existing, and cost. In many cases the horizontal cylindrical form is all-sufficient, and sometimes the best. The cost of construction is usually less than the upright or cheese-box form, on account of the ability to ship complete by flat car from points where tanks are built. An objection to the horizontal tank, however, is that by reason of its proportions, unless extreme care is observed in unloading and placing on the foundation, the seams are liable to be strained and leaks caused. Another objection is that unless one has carefully worked out an accurate table of capacities for each half-inch in depth, etc., it is difficult, in horizontal cylinder tanks, to take correct account of stock of oil on hand. for, owing to the cross-section of the tank "falling away," each half-inch of vertical depth does not mean the same number of cubic inches as in the cheese-box form, but a different number. As a rule, and especially in the larger works, the vertical cheese-box form is the best, by reason of the simplicity of measurement and the greater economy of space secured. Whichever form is used, the tank should be made gas tight as well as oil tight.

Water Top.—Under some circumstances tanks are built with a water top. This provides for a few inches of water to be kept on the top of the tank to keep the head at a nearly uniform temperature and thus minimize evaporation by lessening the contraction and expansion, and hence the starting of joints and leaks. Manholes should be provided on either form of tank, both on the top and on the side near the bottom. Those in the latter location are used in clearing out any sediment or "B. S." which may accumulate.

Quality.—In ordering oil tanks especially it is wise and economical in the long run to buy from some concern who thoroughly understand tank construction, and not on the cheapest prices irrespective of merit. Low cost in oil tanks, as well as in any gas works construction, may mean "skinned" work, a chronically leaky tank, and a long series of trouble. On oil tanks, for paint, use good asphaltum or plumbago makes.

Vents.—All tanks must have an air vent at the top to prevent a vacuum and undue pressure when emptying and filling respectively, and also to allow any evaporation to pass off, preventing accumulation of vapors on the inside of the tank. Such a vent should connect by pipe to the inlet to the gasholder and not into the air: an open vent permits of odors and is a possible source of danger, and perhaps loss of oil as well. Any oil vapor which passes over by evaporation is carried into the inlet of holder and may be saved.

Setting.—The horizontal form of tank may be set either above or below the ground level: the latter plan, on sills, is the more common practice on account of general ease of access. In setting this kind of tank under ground it should never be buried in the earth and access to it at all points so prevented. It may settle, and 5 or 10 per cent. of oil leak a year undetected. It should be placed in a pit sufficiently large to allow passage around the tank, and this pit should be laid up with a retaining wall of brick or stone so that no earth is brought into contact with the surface of the iron or steel, as rusting of the joints is apt to result and leaks follow. The cheese-box form of tank may be carried on any good concrete foundation, leveled off true. The tank should be entirely exposed to view.

Foundations.—The very best foundation construction is probably as follows: There should be built an outer ring of solid brick or stone work, of sufficient thickness to safely carry the weight of the tank filled with oil, with radial cross walls carried through like spokes in the center of a circle. On the top of these walls I-beams or railroad iron should be placed for the proper supporting of the bottom sheets, these beams being set flush with the top of the walls. Drain pipes should be provided to keep all dry. At several points in the outer and cross walls, openings should be left large enough for a man to pass through, thus allowing the bottom of tank to be gotten at in case of necessity. While this is probably an expensive setting, it is a superior one. Large sized tanks should be set on good solid, level foundations, so constructed that in case of settlement all parts will settle alike.

Pits.—As a general maxim it is safer, and hence preferable, to set oil tanks in a pit, as in that case, in the event of a possible rupture of the tank from any cause, the oil is held at that point and cannot flow over the premises. A low bank of earth concentric with the tank will answer the same purposes often when above ground, and is inexpensive.

Shelter.—Where possible all tanks should be provided with some shelter for protection from the rays of the sun in summer and from the snows of winter. This shelter should not be built of wood, but be made as nearly of fireproof material as possible. Corrugated iron will be found satisfactory.

Steam.—In the colder portions of the country, for tanks in which crude oils or heavy distillates are liable to be stored, a good plan is to place in the bottom of the tank, on the inside, a coil of pipe connected with the steam plant; by this means it is a very easy matter to keep the oil in condition to flow. Trouble from sluggish flow is not often experienced, but as at times it is desirable (during the periods of speculative manipulation of the prices of naphtha and crude oil to a temporary high figure), to turn to the use of cheaper "distillates," "intermediates" and "heavy" oils, it is well to have all devices for their easy handling.

Isolation.—It is not essential in locating the tanks to isolate them from buildings, although it is probably a better and safer plan to do so to a reasonable extent, as with the best of care gross carelessness may occur on the part of some employe in conjunction with a light.

Stock.—The question of the amount of oil necessary to keep on hand is decidedly important. In works of small and medium size, plan for at least 60 days' supply always on hand. In larger plants, having more regular shipments, 30 days' supply should be kept on hand. By having ample supply to depend upon, all danger is practically eliminated of shortage which might result from delays in shipment, railroad strikes, or other causes. It also provides somewhat against unusual and temporary fluctuations in the oil market when not working under contract by the year. The tank should always be kept full and shipments arranged to come along regularly having this end in view. This is a matter that can be easily systematized and accomplished when once properly started.

HANDLING.—*Pipe Lines.*—Pipe lines from the unloading point to the works should of course be carefully laid, and preferably in a tight box, or through a condemned gas main. Drip pipes connected to this main and conducted to a central point will indicate any leakage which may occur. The oil pipes in and around the tanks and works should all be exposed, either in an open trench or above ground, so that the joints can be seen and any possible leak quickly discovered and remedied.

Size.—The main discharge pipe from the tank car to the tank should be of threaded iron pipe, and at least not less than 2 inches in diameter—2½ or 3 inches is better. All joints should be made with a good plumbago grease. There are several makes on the market. When this cannot be had a good turpentine soap used by itself will make tight joints. All joints should be well screwed into place, great care being observed that all threads are perfect before laying; this is very important.

Coating.—Any wrought iron pipes that may be laid in the ground should be well coated to prevent rusting, as, in the case of services, if for no other reason, if coated and preserved, these pipes can then be used at any future time for any other purposes without danger if taken up.

Bends.—Do not use elbows or T's in the main pipe lines unless unavoidable. The sharp turns cause friction and retard the easy flow of the oil. Only easy bends or "springs" made of the pipe itself should be used. Whether oils are handled by gravity or pump, air or water pressure, an easy, natural flow means a saving of time and expense. A minimum of sharp turns saves friction and conduces to this. Before using any pipe it is very essential that it should be thoroughly tested to prove its tightness. This can be easily done by filling the pipe with water, and the use of a pressure pump and gauge.

Gravity Unloading.—Where the lay of the land permits (that is, where the railroad tracks are at a higher level than the storage tank) oil cars can be and usually are emptied by gravity. The main unloading pipe should never be carried under the rails of the track, but be stopped a few feet distant from them, and connection made with the valve under the car by means of hose.

Pumping.—Unloading by gravity is convenient and lazy; a better and safer plan is to pump, and arrangements should be made in all cases to do so where possible. It is easily done by having a connecting pipe carried up to, over and down through the dome on top of the tank car. In the event of any trouble occurring with the valve under the car, or of water in the oil settling out in transit, or freezing at that point, it is almost essential. Some oil companies state that all cars should be unloaded by the overhead pumping plan, claiming that the valve below is placed there simply for convenience in cleaning the car, and should only be used for that purpose. Their position is taken so as to avoid liability for damages in case of any accident or loss of oil which might result in unloading through the bottom of the car.

Track Box.—A very good arrangement at the track where the car is unloaded is to inclose the pipe riser in a wooden box made of 2-inch plank; this box should be made with a hinged cover, and when not in use it should be strongly padlocked. This will prevent small boys or others bent on mischief from filling the pipe with pebbles, stones or other foreign matter.

Unloading Hose.—The coupling for making connections to the bottom of the tank car must be of special design and pattern, as the thread on the tank car is a 4-inch special, having but four threads to the inch. The hose may be made of rubber on a flexible wire frame, and should be about 8 or 10 ft. long, and complete with special tank car coupling at one end and standard pipe thread fitting at the other. It should be removed and stored, free from kinks, in the gas works when not in use. Theoretically, a pump will lift water about 34 feet; practically, about 28 feet. On account of its greater volatile properties, oil cannot be raised this distance. It is not safe practice to set the tank pump so that it will have to lift to exceed 22 feet vertically.

Ice in Car.—Occasionally in winter a car of oil is received in which the water from the oil settles around the outlet valve and freezes, and, unless rigged to pump out from the top, as above, it will be necessary to provide some means for thawing the ice. A good plan to adopt, if the distance from the works is not too great, is to carry a small steam pipe from the boiler through the oil pipe to the track, and by the medium of a hose the steam from this can be utilized in opening up the stoppage by a coil or return bend of pipe lowered through the dome. For long distances, either a portable boiler can be used or crude oil can be moderately heated at the works and carried to the car in barrels and brought into contact with the ice through a pipe placed through the manhole on the dome, with the lower end against the ice in the bottom of the tank. This method, I understand, has been used with success by Mr. McKay. Troubles of this kind occur but seldom, but as long as they do occur it is well to be prepared to meet the emergency.

Samples.—Each car of oil when received, and before it is emptied, should be roughly checked or tested; oil companies, either by accident or otherwise, sometimes send "doctored" oils. A gallon jar of the oil should be taken from each car, labeled and dated, and kept until all chance of dispute has disappeared; this sample oil can be later analyzed in the event of necessity arising. In addition to this test, every gas company should have a hydrometer and test to see that the gravity of the oil received is according to contract. These hydrometers can be obtained from any good instrument maker, such as Queen & Co., of Philadelphia, and cost about $3. If the oil is not received as ordered, by having kept samples and made these tests, the companies are in shape to make a just claim for rebate.

Car Capacities.—All gas works using oil should be provided with a copy of the "Tank Gauge Hand Book, No. 2." This can be had from the Central Traffic Association, The Rookery, Chicago. This hand book contains the capacity of every tank car in use for hauling oil in the United States. In addition to this book the Association should be asked to send all supplements that may be issued. When a car is received, by consulting this hand book and comparing the quantity given therein with the bill, it can readily be ascertained if there is any mistake made in amounts. A tank car is considered full when the oil enters the bottom of the dome on top of the car. It is not intended to fill the dome. If the car is not full it should not be unloaded until the shipper has acknowledged the shortage.

Temperature.—In taking account of the oil in the main storage tank, the measurement in gallons should always be corrected for temperature. Oil increases in bulk 1 per cent. for each 20° above 60° F., and decreases 1 per cent. for each 20° below 60° F.

Engine Sparks.—Frequently the gas company's switch where the oil is unloaded is close to other tracks, and engines in passing are liable to throw out sparks which may be dangerous. To prevent trouble by fire from this cause, a sheet-iron cap should be provided and placed over the dome of the car when unloading. This cap should not fit tightly, but be rather in the form of a "bonnet" or inverted loose can, so as to allow for the admission of air to replace the oil as it flows from the car.

Piping Tanks.—In piping storage tanks of any form carry the inlet or filling pipe through the top of the tank, extending it down to the bottom. Make the lower end of this pipe U-shaped, or by a return bend extend it up again about 12 inches from the bottom. This will allow the oil to run in without stirring up the sediment which may be in the bottom of the tank. The outlet pipe should be arranged in the same manner, thus preventing drawing out the sediment or water. A separate pipe should be provided for the latter purpose. This latter pipe should also be carried down through the tank top and should end close to the bottom. Sediment pumped out through it may be used with the boiler fuel. All pipes should enter the tank through the top. No connections should be made at any other place.

Measuring.—Although it is preferable to use a meter in measuring the oil at the works, for the reason that a continuous registration is had, essential for checking the gas maker in the amount of oil used, yet, as the meter may at times vary, a small tank of known capacity should be used for testing the meter by comparison at least every week. The piping should be so arranged that the oil can be pumped from the small tank through the meter on its way to the apparatus. In all cases a wire strainer should be placed between the pump and the meter, to prevent foreign substances getting into the meter. For further points on piping and measurement, I again refer you to Mr. McKay's paper.

Lights.—It is not considered good practice to carry lanterns or lights around the oil tanks, nor to look for leaks except with daylight; pyrotechnic and serious results may follow. Oil is a good servant but a bad master. With reasonable care it is practically entirely safe. With carelessness the combination of oil vapors and air contains much power for damage. Witness this instance, wherein a recent dispatch through the Associated Press conveys some idea of the consequence of bringing a light and oil or oil vapors together—two men with a lighted candle went into the tanks to clean them:

"San Francisco, Cal., March 8.—A terrific explosion on the tank of the steamer Bawnmore, lying at the Artic Oil Works dock, at the Potrero, caused great excitement in that section of the city to-day. Two men were terribly bruised and burned, receiving what are thought to be mortal injuries, and the vessel was badly strained. Everything on board was thrown into the greatest confusion. The Bawnmore recently arrived from Peru with a cargo of crude petroleum consigned to J. W. Grace & Co. The cargo having been discharged, two workmen carrying a candle went into the tanks this afternoon to clean them out. Instantly an explosion came, shaking the steamer from stem to stern, twisting the tanks out of position and smashing the surrounding woodwork. The two workmen were carried out in an insensible condition."—Chicago *Inter-Ocean*.

A strict rule that should be maintained absolute under all circumstances is to allow no lights or smoking anywhere near the tank; any employee disobeying this rule should be discharged at once. If modern fire extinguishers are kept in the works, have some handy to the oil pumps, valves, piping and spots where oil may be spilled.

Tank Wagons.—While oil pipe lines may be a mile in length if necessary, in certain localities the gas works are so situated that it is impracticable to lay an oil pipe to the works from the railroad; in this case a tank wagon furnishes an excellent substitute for the pipe and is perfectly feasible. A double-horse team rig of running gear and tank of 600 or 800 gallons capacity complete will cost in the neighborhood of from $300 to $400. At a point near New York City I understand that with this method in use a haul of 3 miles adds only about one-half of a cent per gallon to the cost. Taking as a basis the well-determined figures that 2 tons, or 4,000 pounds, of good gas coal will yield 20,000 cubic feet 17-candle power coal gas, and that a ton of oil and a ton of anthracite together, or 4,000 pounds, will easily produce 50,000 cubic feet of a better candle power water gas in a modern setting, it can be readily seen that the hauling of oil in tank wagons is entirely practicable and cheaper per 1,000 of gas to be made than to continue to haul the materials for coal gas manufacture. Gas companies situated away from a railroad certainly need not be deterred from adopting water gas on account of distance from the tracks. In using tank wagons, it is of course, if possible, best to arrange to drive directly under the tank car for easy loading. Arrangements can usually be made with some local coal yard for the use of their trestle, especially if you should buy your anthracite or boiler coal there.

The sundry points noted herein are sufficient for most practical purposes, but in now committing this paper to the tender mercies of your discussion additional desirable points can be brought out I am sure, and I trust will be.

DISCUSSION.

The President—This interesting paper contains a great deal of valuable information. Mr. Collins will be pleased to answer any questions.

Mr. Humphreys—Mr. Collins has given us quite a number of very valuable suggestions in a very practical shape. I would like to ask him as to one or two points, and especially to raise a word of warning. My first reference is to what he says about horizontal tanks, that the cost of construction is usually less for horizontal tanks than for the upright or cheese-box form. I think Mr. Collins has fallen into an error there. That statement may possibly be true with respect to very small upright tanks, but as you increase in size the cheese-box form is much cheaper. It is a question in my mind whether it is good practice, simply for the sake of the extra convenience on a very few occasions, to put a manhole plate on the side of the tank. You can clean it from above. You very seldom have to clean it out; certainly not more than once a year. You do introduce a slight extra risk by having any bolted joint on the side of the tank. I am inclined to think that the better practice would be to leave off the manhole at the side. As to the vents: If anybody contemplates connecting the tops of their oil tanks with their coal gas supply, I would advise them to first thoroughly investigate the subject. If you do make this connection you must see to it that you do not carry over a large amount of vapor from the top of your tank to your gas mains. I have known of works in quite large cities where the manufacturing records were thrown out of adjustment altogether by this carrying over of vapor from the oil tank. The worst case I know of was an unprotected tank, exposed to the sun in the open air, and storing naphtha. Therefore, if you contemplate anything of that kind, be very careful where you place and how you build the tank. In no case would I recommend that such a connection be made if you are going to use naphtha. Referring to the question of piping to the tank: Before you decide to put in a suction pipe through the top (and I am very much in favor of having all connections at the top if possible) see whether you can lift the oil the required height. There are some tanks in this country which are deep enough to absolutely prevent it: and especially in view of the "trapping" of vapor. You cannot give too much attention to the danger of fire. I suppose a large majority of the oil fires that have occurred in water gas plants in this country in the last ten years have come, not from the tanks, but from the connections, and perhaps a large proportion of those have been right in the generator house: and a large proportion of these again have occurred in the first instance in a very small way, so that if they had had instant means of relief the fire would have been prevented. Water in that case is very often valueless. It simply washes the fire around. A very good and safe measure is to have dry sand in such a form and place that you can get at it instantly—as in a box reserved for that purpose, where the sand can be kept clean and dry—with a convenient scoop; and have it understood that it is a sufficient reason for the discharge of the employee responsible if the sand is used for any other purpose—just as it should be in the case of a fire bucket. It is astonishing how quickly fire can be put out by the prompt application of a little dry sand.

MR. THOMPSON—By a coincidence the "Wrinkle Department" contains an item concerning the unloading of tank-cars almost identical with two of Mr. Collins' suggestions. I desire to express my hearty agreement with his suggestions, especially as regards having the tank built by a firm which thoroughly understands the work—as to laying pipe-lines in tight mains—as to venting tanks into holders—and as to sampling car shipments. We have been using naphtha almost without interruption for a number of years, and for nine years in my own experience we have had our tanks vent into the gas holders, and have had no difficulty whatever. Mr. Collins speaks of transferring oil in tank wagons if railroad facilities are lacking at the works. It might be suggested that such wagons are very desirable for handling the drip-condensation; and the same wagon may be used for both purposes. In St. Louis we rather reverse this arrangement, in having a *drip-wagon* which we occasionally use for transporting oil from the larger plant to our Pintsch works. I would add one point to those made by the paper. I think it quite desirable to have a quick opening valve controlling the entire oil supply to the generator house, in order that the danger may be minimized in case of an accident to the gauges in the supply tanks. The statement is made that in piping storage tanks the pipe should enter the tank through the top. I would ask Mr. Collins whether he would not modify that statement in case the tanks are 22 feet in height, or where it is impracticable to pump oil that distance?

MR. A. S. MILLER—If a large steam pipe is put into the tank it may sometimes save trouble in case of fire, because burning oil can be very easily extinguished in a closed vessel by the use of steam. In respect to the connection of measurements for temperature, I would like to ask Mr. Collins if 1 per cent. for each 20° above 60° F. is the absolute expansion of oil, or whether it is the differential expansion in the iron tanks. Of course the expansion of oil in iron tanks would be differential expansion; and so it would not be fair to subtract 1 per cent. in case the temperature of the oil in the tank were 20° above 60° F. I would like to know from him what the differential expansion would be.

Mr. Collins—I am unable to state just what the differential expansion would be. The correction for temperature given is approximately correct. Replying to Mr. Humphreys and Mr. Thompson: I think their suggestions are good; but, as I stated originally, this paper was more particularly intended to apply to small or medium sized works, while the most of Mr. Humphreys' remarks related to works of larger size. For small works I think the horizontal form of construction of small tanks is less expensive than the cheese-box form. His suggestion as to the use of sand for extinguishing slight oil fires is good, but I think that a properly working fire extinguisher can also successfully handle small fires.

Mr. Humphreys—I have to take issue quite decidedly with Mr. Thompson on the question of venting. I would like to have him explain in detail how that tank of his is arranged. I can hardly understand how they can have used that arrangement for nine years without finding that a large amount of vapor has gone away. Has he not found a shortage in the oil tanks? Has he not found that the results generally failed to check up? Is it a covered tank?

Mr. Thompson—During the greater part of the nine years the tanks we had in use for storing naphtha were at a portion of the works quite remote from the outlet main to the street, and the pipes had to be carried through the top of the tank and connected with the gas supply pipe between the storage house and the blacksmith shop. Then a 2-inch wrought iron pipe was carried to the distant outlet main, 400 feet away, and any condensation above the quantity which you would ordinarily expect to find in an exposed gas supply pipe was removed at the nearest drip from this gas supply pipe, say at a convenient lamp bracket at the corner of the storage shed. We have never had any undue quantity of condensation. In our large tank lately erected we vent directly into the inlet pipe into one of our holders, with a drip midway between.

Mr. Odiorne—I have had an experience of that kind. We connected a vent pipe with the holder inlet, or at a service pipe from the holder inlet, extending down through the gas house yard to a couple of houses below, occupied by men who worked for the gas company. It being so handy, we connected it right on to that service. We found after a while that these men complained that the gas did not burn well. We investigated it and found that the vapor was carried over there, and that the gas gave them very little light at all. It did all right with a Welsbach burner, but with an ordinary burner it gave scarcely any light. We had to abandon that plan.

Mr. Shelton—I think it is not intended that the figure of contraction and expansion under changes of temperature (which is given by Mr. Collins as at about 1 per cent. for each 20° above or below 60°) shall be taken as an arbitrary figure; but that, roughly speaking, and under the conditions referred to, the degree of expansion is about

1 per cent. for each 20°. I think if there are any oil people here they may be able to state definitely the ratio of expansion. In the last page of his paper, Mr. Collins refers to the fact that the cost of hauling oil in a tank wagon a distance of three miles is about half a cent per gallon; but in conversation with the manager of the place in question this morning, I find that the cost is only about a quarter of a cent per gallon, which is a proper correction to be made in the discussion here.

Mr. Humphreys—I do not want to seem to be too persistent, but as the matter is very important, I would like to have Mr. Thompson answer the question about the way in which the oil is stored. Is it a covered tank, and was it equipped with a water top? Does he sprinkle the tank in very hot weather? We know that these light naphthas can be carried forward with the gas and carried out into the streets. We know there is such an apparatus devised and in regular use for the purpose of carbureting millions of feet of gas per day. The case I have particularly in mind is the works that Mr. Collins himself was Superintendent of. I do not know whether he was the Superintendent at that time, but I do know that the trouble was considered serious enough for me to go from Philadelphia to Omaha to look into it; for the quantity of vapor that had gone over had entirely upset our record of results. We were making apparently a fair gas from a low quantity of oil; but still that fair quality of gas, after it got to the streets, was smoking everything up, and blackening the street lamps. We made a long series of experiments as to the amount of vapor carried over into the gas main, and found in that item the source of our oil shortage and the source of our excess of vapor in the gas. When the sun was on the tank, so rapidly was the vapor made that, with the vent closed, none of our ordinary pressure gauges were sufficient in length to measure the pressure created, and we were obliged to make gauges of extra lengths for the purpose.

Mr. Thompson—The two tanks which we have used the longest, and which are still in use, are under a covered shed. They have a capacity of about 17,000 gallons each. The third tank, and the largest, was erected in October, 1893, and has been in use during the last summer. It is a tank of the cheese-box form with a trussed crown and holds 107,000 gallons. There is no water top and we have used no form of sprinkling. It is in the open. I might add that we receive our oil under a standing order or arrangement by which the quantity in the tank seldom varies very greatly from day to day. The oil comes in almost the quantity used daily, so that there is no very great fluctuation in the quantity of vapor in the tank. There is a sufficient line of piping to connect it from the tank to the holder, so that the gas pressure is constantly on oil in the tank. While I have made no tests of the amount of vapor passing between the tank and the holder, I do not consider it very great, because we have no oil condensation in the drips.

Mr. Clark—I want to call attention to the fact that Mr. Collins, while recommending a vent in the oil tank connecting with the gas main, also recommends that the tanks be covered. I cannot believe there would be any bad effect upon the gas in using the vent from the oil tank to the holder, if the oil tank is covered. We have quite recently decided to connect the vent on a tank of 300,000 capacity with our foul main, and have made careful calculations to determine the amount of evaporation we may get, and we are persuaded that the vapor will not have any observable effect upon the gas. I cannot believe there will be any material condensation of the vapor that goes off from the naphtha tank at atmospheric temperature; and, while drips will be provided, I anticipate there will be nothing in the drips from this connection between the tank and the main. It must be remembered that as oil is being used from the tanks the gas flows back into the tanks, of course discouraging evaporation to some extent. I thoroughly agree with Mr. Humphreys in recommending that sand be at hand to prevent fires, but I do not believe that sand would be sufficient in case of fire in the oil tank. It may be used to put out fire on the generator floor, but I doubt if the men would be willing to use it with the shovel in case of fire in the oil tank. I have had a talk with a man who has had a great deal of experience in extinguishing oil fires, and he tells me there need be no apprehension of any disaster from the tank if you can get steam into it quick enough after the fire starts. We are going to connect up our large tanks with the boiler, with a large connection from the main, so that we can throw into the tank all the steam that the boiler makes to stop a fire.

Mr. Humphreys—Connecting with the foul main and with the purified gas are quite different things. The former is the better practice. Let me suggest also that you may carry over lots of vapor and yet never find a show of it in the drip. And I did not expect to keep a sand box on the top of the tank from which to shovel sand into the tank in case of fire in the tank.

Mr. J. W. Stratton—I would like to inquire of Mr. Clark what effect the flow of steam would have in the closed naphtha tank?

Mr. Clark—I think the steam flowing into the top of the tank will condense first and then drive out through the vent whatever vapor, or mixture of vapor and air, may be in there, and that the steam will occupy its place. The capacity of the average oil tank of the cheese-box pattern is very much greater, many times greater, than that of a steam boiler. I should not fear to open the steam boiler into the top of a large oil tank and keep the fire going under the boiler. There would be a very rapid condensation in the tank, and there must be some vent in the tank which would take care of the steam under the pressure which would arise.

Mr. Shelton.—What arrangement would Mr. Humphreys adopt in preference to venting into the inlet of the holder? What would he recommend as a standard arrangement?

Mr. Humphreys—I am not at all sure what I would recommend. I think that is the hardest nut to crack in connection with the storage of oil. If I were going to store heavy oil, and felt sure that, say, 90 per cent. of my oil was to be distillate, or other heavy oil, I would then connect with the crude gas; but if I could not do that I would connect simply into the air with two relief valves, one opening in and one opening out, and very carefully cover the openings with brass wire gauze. We would lose that vapor, but we would rather lose it than get it into the gas not fixed. Of course we should take every possible care to prevent fire by selecting a proper position for the tank.

Mr. Forstall—Mr. Collins dismisses the matter of unloading by gravity as being "convenient and lazy;" but there are some situations where it is almost impossible to do anything else, and there are some precautions which may be taken in that case. At Newark we very rarely handle oil by tank car, although occasionally we have to do it. Our switch is some 700 feet from the works, and about 30 feet higher than the works, so that pumping is entirely out of the question. We have to run the oil down by pipe line through the street. We have no boiler anywhere near the switch, and do not carry our steam pipe up there for the simple reason that we seldom use the switch in unloading. So we have to unload by gravity. Of course we make a perfectly close connection between the bottom of the tank and our unloading tank, with a rubber hose fitting the tank connection with a tight fit. In case of a leaking tank valve, we take up always, before we start the tank, a quantity of coke breeze, and pack that directly under the tank car and under the outlet before we loosen the cap at all. It is seldom that a car leaks so badly that the breeze will not absorb the oil that comes out, and it is only a question of a minute to get the tank connection closed up so that there will be no leakage at all. We are within 10 feet of the through line track on which suburban trains are passing every half hour; and it is our rule that nothing shall be done to the tank car, either by opening the dome or opening the valve, if there is a train anywhere in sight. When we do open the dome to lift the valve it is immediately closed. We work through a vent pipe, and cover that with wire gauze of about 100 meshes to the inch, and I think that obviates all danger of any spark lighting the oil vapor and getting back into the tank. We have used it for two or three winters and have never had the least trouble with it. As for freezing, we have very little trouble from that. Of course there is less trouble with naphtha freezing than there would be with crude oil, as water is more apt to be in crude oil than in naphtha. We always take up enough hot water to thaw out the valve by outside application.

Mr. Butterworth—Mr. Collins' paper is full of valuable hints, and will be read by us all in connection with any work we may have to do in storing oil. I move to him a very hearty vote of thanks. (Seconded by Mr. Odiorne, and carried.)

REPORT OF MEMORIAL COMMITTEE.

Mr. Butterworth read the following report of the Memorial Committee, which was, on motion of Mr. Shelton, adopted by a rising vote:

It is the painful duty of your Committee to chronicle the death, during the past year, of two members of this Association, one of whom was among the youngest, and the other among the older of our members—Mr. Henry C. Felt and Mr. George H. Wells.

Henry C. Felt was for several years past agent for the American Meter Company, with headquarters at Cincinnati. He died at St. Louis, on January 7th last, in the 24th year of his age, and was buried in that city with full Masonic honors.

Geo. H. Wells was well known to the members of this Association and to the fraternity at large, having been for a quarter of a century the Superintendent of the Nashville (Tenn.) Gas Light Company. He died in Nashville, on November 22d last, aged about 63 years, and he also was buried in accordance with the Masonic ritual.

Your Committee recommend that proper recognition be taken by us of the death of these two of our number, by instructing the Secretary to communicate with their families in expressing to them our sorrow and regret at the loss which we have sustained, and, also, that a proper record be made of this action in the minutes of the Association.

IRVIN BUTTERWORTH,
C. H. EVANS,
JAS. FORBES,
Committee.

REPORT OF COMMITTEE ON PRESIDENT'S ADDRESS.

First Vice-President Odiorne took the Chair, and Mr. E. H. Jenkins, from the Committee on the President's Address, read the following report:

Your Committee, to whom was referred the President's Address, beg leave to report. We feel that we voice the sentiment of the members of this Association in stating our opinion that this address, without disparagement to others, is one of the most valuable, practical and inspiring Presidential addresses that has been presented to the Association for many years, dealing largely as it does in practical data and figures rather than in glittering generalities. That a gas engineer who is so closely in touch with the profession and industry should be able to point out so many new fields capable of development, as well as enlargement of the gas business on the present lines, is especially gratifying and inspiring. We commend the address for careful study and perusal on the part of our members.

We especially draw attention to the interesting and startling figures and facts presented in regard to the possibilities of the utilization of the gas and bye-products of coke ovens on a large scale, whereby a uel gas may be supplied in cities that are now enjoying the use of natural gas, but who may in the near future have to resort to other fuel. In view of the special interest attaching to this particular portion of the address we recommend that the Secretary be requested to secure if possible for our next meeting a paper treating further on this subject. Another important field opened to our view in the address, for the increased use of gas, is that of its employment for street car propulsion. Should its application for this purpose be made successful, the enormous increase to our business would make this topic of great interest to each and every member.

The entire address shows careful and conscientious preparation, and we feel that the Association is to be congratulated in having so valuable a paper presented for its consideration.

E. H. Jenkins,
Irvin Butterworth,
E. G. Cowdery,
Committee.

On motion of Mr. Nash, seconded by Mr. Thompson, it was voted that the report be adopted, and that the Secretary be instructed to have 400 copies of the address printed for future distribution.

President Baxter resumed the Chair and called upon Editor Geo. Treadway Thompson to take up the

WRINKLE DEPARTMENT

Mr. Thompson then read the following Wrinkles:

Clamp for Lowering Standpipes.—When taking down the iron work of a series of benches preparatory to rebuilding, the light "cranes" shown in Fig. 1 were found very convenient for lowering standpipes, etc. The L-piece of the crane or clamp is hung in the outer pipe of the bridge casting, and its curved foot bears upon the outside of this pipe, above the standpipe flange. A block and fall is hung by a hook from the hole in the outer end of the crane, which, being made of 2½-in. x ½-in. iron, is light enough to be moved along wherever required.

St. Louis, April 13th, 1895.

Varying the Superheater Proportions in Making Water Gas.—While running a set of water-gas apparatus of well known type, I recently found proportionally immense quantities of naphthaline in our purifiers, and had to change boxes frequently owing to the pressure before the material was at all foul. After finding and remedying a number of other causes of the production of the pest without banishing it entirely, I found that the proportion of fixing surface in our carburetor and fixing chamber was too large for the quantity of oil necessary to carburet the water gas which we could produce in the generator, so I did the following: Had an oil-pipe nozzle rigged to superheater bottom. By running the oil in at this point every few runs we cleared the obstructions in the purifiers (apparently absorbing the naphthaline previously deposited there, as demonstrated by removal and inspection of the covers), and thus enriched the gas to a considerable extent; that is, made richer gas with less oil for a time, owing no doubt to the absorption of the naphthaline as stated. We aim of course to make neither tar nor lampblack; but while making none of the latter we yet got that naphthaline; and by applying this remedy we made none of the former, with the result stated.

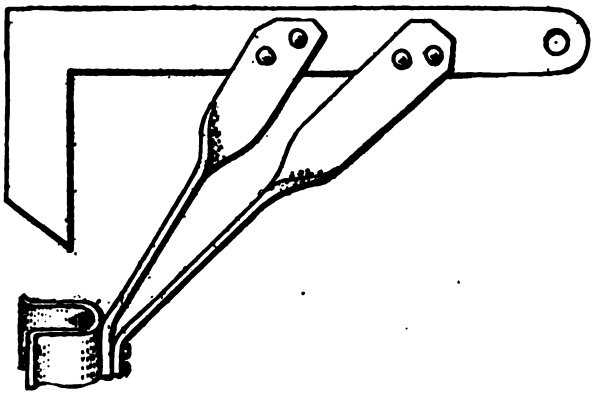

FIG. 1.—Clamp for Lowering Standpipes.

The effect of the use of this "oil by-pass," which has been described, was simply to avoid subjecting the oil and its subsequent vapors and gases to so much heat; the oil-gas was sufficiently fixed, and neither an excess of tar, of lampblack nor naphthaline was formed to any extent. If we had used retort house coke we should have been all right as to proportions of apparatus, because the material in the generator could have been more quickly heated to the proper temperature. But as we used anthracite, and of course to get a suitable heat in the generator had to use the air-blast longer than required with coke, we had a choice of throwing a lot of unconsumed gas into the air, of blowing in an excess of air to keep the heat down, of taking out a lot of fire-brick in either carburetor or superheater, or both, or doing as we did, viz.: by-passing the carburetor occasionally. This last had the merit that if by any chance the heat was *not* too high, the old way to use the oil was still there; and, in like manner, we could use retort house coke at any time. FREDERIC EGNER.

Norfolk, Va., March 12th, 1895.

DISCUSSION.

Mr. Clark—Does Mr. Thompson desire to discuss these various items as they are read, or have them taken up after they are read? Will gentlemen who are not present be permitted to send in discussions?

Mr. Thompson—Last year the practice was to discuss the Wrinkles after they had all been read. As to the discussion now, I may say that the writers of all are not present, and, of course, I cannot answer questions about some of them as understandingly as the authors would. Still many of them are self-evident; possibly others might answer the questions as to some, better even than the author or myself.

Mr. Humphreys—I would suggest that we discuss them as they are read.

The President—If there is no objection we will take that course.

Mr. Thompson—In that case the first two Wrinkles are now open for discussion.

Mr. Humphreys—As to the second, I feel like throwing out a word of warning. By-passing oil in that way might do for a city in the South; but I know a case where they did not by-pass it as seriously as that, and so lost 7 candles while sending it over a bridge. That is not what the superheater or carburetor is there for. I do not believe that any works in the world can have too much carburetor or superheater capacity *if* it is properly used.

Mr. A. S. Miller—Of course, it is very well known that oil vapor will dissolve naphthaline. Mr. Humphreys suggests that this by-passing may answer in a southern city. I wish very much that the author of that paper were here, as I would like to ask him what the costs of meter repairs are at his works, and what effort is made to determine what percentage of the gas is fixed. Of course, it is well known that if oil is vaporized, but not fixed, your results in the works will be higher—I refer to the immediate results. You will get more light per gallon of oil in the works; but if you go to the end of the main to test it, you will probably find you will not get quite as much. I hope the gentlemen will not take Mr. Egner seriously on this subject, or adopt his suggestion too freely; because a long series of experiments has unquestionably shown that it is very necessary to have the oil properly fixed. In connection with the point as to anthracite coal, as a rule more gas is made when anthracite is used instead of coke, and it is all the more necessary we should have more fixing surface in connection with anthracite. If he would blow his machine hard enough—in other words, get enough head between the top and bottom of the fire—he can throw enough excess air in to bring the fire in the carburetor and superheater to a proper temperature at the same time. It can very easily be done if he gets in proper blowers (if he has not them already), for if he will blow his fire hard enough he can get just enough combustible gas on top of the generator to bring the other two vessels to a proper heat. I think it would be a great pity to by-pass the carburetor from any idea that he has too much fixing surface on any machine ordinarily used. I believe he has the ordinary type of machine, and I think it is probably an error to by-pass it.

The next Wrinkles read were:

Enlarged Dials for Oil Meters.—This device has been found very satisfactory in connection with water gas manufacture. The small dials are the same as in regular use on meters. The large hands in the center (see Fig. 2) revolve like the hands of a clock, registering units and tens, one making a revolution for each 10 gallons and the other for each 100 gallons. The dials are placed vertically, so that they may be seen from any portion of the generator house.

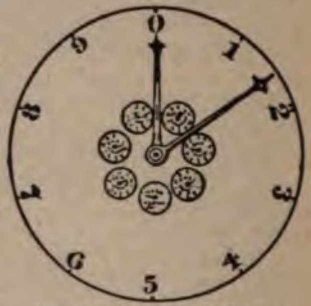

Fig. 2.—Enlarged Dial for Oil Meters.

The large hands may be set to zero without interfering with the continuous registration of the meter; so the gasmaker loses no time in taking the index, and is less liable to error. The small dial is a check on his work. "Incog."

Emptying Oil Cars —In transferring oil to the storage reservoirs on the gas works from the tank cars in which it has been shipped, probably the most common form of attachment to the pumping line is that which is made from the bottom valve of the tank car by means of a union on a length of rubber suction hose. But the life of a hose used for this purpose it necessarily short, especially when naphtha is handled; and the bottom valves of the tank cars are frequently found leaking when their caps are removed. These difficulties entail expense, loss of time, and often a considerable loss of oil; and in cold weather it is no easy matter to connect the union below a leaky valve, with the rapidly evaporating naphtha pouring over one's hands. Dangerous and disastrous fires have also occurred from leaks of oil from the valves of the tank cars.

For these reasons we have long since discontinued the use of this method of unloading oil. Instead, we provide a line of pipe terminating with half a flange union at a point beside the track, and a little higher than the dome of a car. Another piece of pipe long enough to reach the bottom of the car; with an elbow, a short length of pipe, and the other half of the flange union, is attached when the car is set. This completes the connection, permitting the car to be emptied without touching the valve, and without any rubber hose to be dissolved or to kink and harden. The attachment to the pumping line is much more easily and quickly made when using the valve, and the system has been most satisfactory in every way.

Lest a spark from a passing locomotive might fall into the dome of the car, the opening is protected by a light sheet-iron cover, having a slot to admit the suction pipe, and a slide hinged on a rivet to cover all but the 3-inch pipe opening when all is adjusted.

St. Louis, Mo., April 12th, 1895. GEO. TREADWAY THOMPSON.

Safety Devices for Exhauster Engines.—An instance of the differing methods by which corresponding results may be attained is shown in the devices used at two stations of the same gas company, to prevent the exhauster engines from "running away" in case the load should be suddenly thrown off by a breaking belt or similar mishap. In the first case the ordinary float of an exhauster governor is provided with a gas connection from the inlet main of the exhauster, and so weighted that it hangs well down in the tank while the desired vacuum is maintained. The arm from the bell is attached by a chain to a throttle valve on the steam pipe to the engine, and this valve is thus held open when the float is down or nearly so. Any mishap resulting in the stoppage of the exhauster would change the vacuum to a pressure, raising the float and stopping the engine. In other words, this device is used in addition to the usual governor, and exactly reverses the action of the latter after a certain limit is passed.

In the second instance the possibility of a broken belt was most to be guarded against, and the belt in question ran horizontally, any stretch being taken up by an idler which hung between iron arms projecting from a wooden frame. From the idler a chain was run over pulleys to a lever attached to the stem of a butterfly valve in the engine steam pipe. A breaking of the belt would drop the idler, and so shut off the steam.

While fortunately neither of these devices has yet been required in the emergencies for which designed, they both received experimental trial under working conditions when first installed, and operated satisfactorily. GEO. TREADWAY THOMPSON.

St. Louis, April 13th, 1895.

DISCUSSION.

MR. A. S. MILLER—I would suggest in such a case the use of the ordinary ball governor on the engine. The ball can be set at any speed above which the exhauster is run, and that would catch the engine in case the load was light. The engine would only run up to the speed at which the governor was set.

MR. CLARK—I understand when the exhauster is run on coal gas a varying speed is necessary to control the pressure on the hydraulic main, and that there the ball governor would not do at all.

MR. A. S. MILLER—You can get it above any speed which would be run in practice; and then, in case the belt should break, it could only be run up to the speed at which the governor was set.

The next Wrinkle read was:

Avoiding Nuisance when Opening Purifiers.—In the case of works centrally located, or where for any reason all nuisance must be reduced to a minimum, some arrangement such as the following is advisable for expelling and burning the offensive gases occluded in the material of the "off" purifying box before lifting the cover preparatory to changing the material, or when reviving the material by blowing air through it. A large iron pipe is run from underneath the boiler to a convenient point near the center seal—say close to the inner corner of one of the boxes—and terminating just above the floor, where it connects with a large rubber hose of sufficient length to allow its other end to be connected in turn to the cap holes in the covers of the different boxes. Air is blown through the "off" box by a suitable blower connected to the gas inlet, and the foul gases occluded in the material are thereby driven off through the iron blow-off pipe to the boiler, and there consumed. At a convenient point in the blow-off pipe a tight seal box should be placed, with sealed overflow set to maintain a shallow water seal, through which the gases are forced in order to prevent an explosion in the purifying box in case these gases should "light back" in the blow-off pipe at the boiler. While the blower is in operation it is well to allow a small stream of water to run constantly into the seal box in order to avoid the possibility of the pipe becoming unsealed by evaporation or otherwise.

Columbus, Ohio, April 8, 1895. IRVIN BUTTERWORTH.

DISCUSSION.

MR. HUMPHREYS—I would be afraid of that. It appears to me there would be nothing between you and trouble except a shallow water seal, and anything going wrong with that seal would likely lead to a disastrous explosion. I think that should be adopted only after much anxious thought.

MR. BUTTERWORTH—We have had that method in operation in our works for several years and have had no accident; nevertheless it may be dangerous. With us it is very important that we should reduce all nuisance to a minimum.

MR. HUMPHREYS—I know some who were absolutely forced to do something in that direction, and made such an arrangement as Mr. Butterworth describes, but without a seal. They ran along for quite a while without an accident, but finally had one. Then, I believe, it went right along again, and they have had no accident since. Whether they introduced any safeguard after the initial accident I do not know.

The next Wrinkle was:

Steam Hose Attachment for Holder Cups.—Steam hose on holder cups usually give out first at the end of the nipple, as shown by the dotted lines at *b*, Fig. 3. We obviate this difficulty by the use of a support or bracket *a*, which is placed under, and clamped down with, the hose. As the holder rises the hose falls into the support, and, following its lines, cannot get kinked or bent enough to harm it. The hose is attached to the grip by the usual clamps *d* and *e*.

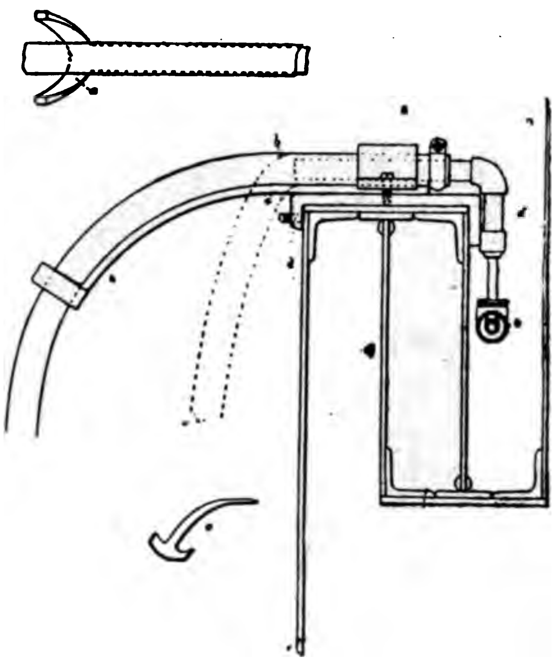

Fig. 3.—Attachment for Steam Hose on Holder Cups.

R. B. Brown. (Communicated by A. E. Forstall.)
Newark, N. J., April 6, 1895.

DISCUSSION.

Mr. A. S. Miller—What is the matter with bending a pipe, or passing the hose through the pipe?

Mr. Thompson—There are a number of instances where pipe is bent for that purpose. Another method for obviating the difficulty is to use an elbow, with a short nipple attached, to hold the hose, and with this nipple hanging down the side of the holder instead of laying it across the top of the cup. These are simply different methods of reaching the same result.

The next Wrinkle read was descriptive of a

Pressure Board.—Fig. 4 is a sketch of a pressure board such as I am using in this works. You will see I have five pieces of apparatus attached on this board. I have not marked them as I have them on my board, as any piece can be marked as the pipe comes to it. My board is: No. 1, washer and scrubber; No. 2, meter; No. 3, outlet center seal; No. 4, scrubber No. 2; No. 5, purifiers. Any other arrangement can be made as desired.

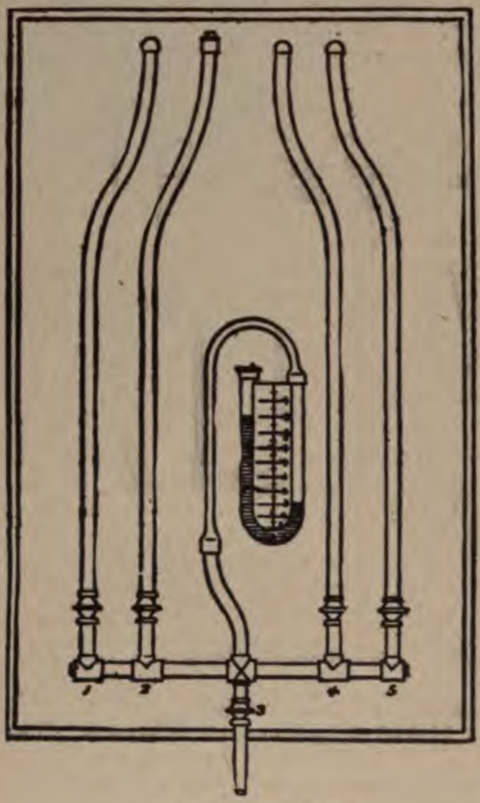

Fig. 4.—Pressure Board.

This board is attached to the wall, and pipes leading thereto are brought from any parts of the works to it, and connected on opposite sides by union. The pressure is readily shown by *one* guage instead of five.

Another device I use is a paper attached back of guage with the highest pressure recorded thereon. Say, when we are pumping oil and the largest volume of gas is passing, I take the extreme pressure given and mark same down on this paper. This shows me my extreme pressure; so when working regularly any increase is shown and the trouble very readily located and remedied.

Pipe No. 1 I leave on at all times, as this gives me the working pressure through all my purifying apparatus. W. Tracy.

Leavenworth, Kas., April 4, 1895.

DISCUSSION.

Mr. T. D. Miller—I had a device like that which I used, but it has not worked satisfactorily yet. The long line of pipe became stopped up in some way and required constant steaming up. You never can rely upon the pressure to get over that sort of device.

Mr. Thompson—I think a similar device to this has been employed in Columbus, O., and in Galena, Ills.; doubtless there are others in addition. There is the difficulty, to some degree, that Mr. Miller mentions, but it nearly always exists at the point where the pressure pipe leaves the larger main. These pressure pipes have no valve there to them; but if properly connected there should be no special difficulty in keeping them clear.

Mr. Hinman—Has this device been in use for some time?

Mr. Tracy—I have used it for a year.

Mr. Miller—I have used it now for a number of years, but can never rely on the pressure. I get such astonishing results at times that I do not rely on it at all. I have had new pipe put in, and when running rather large sometimes I would find the pressure would be higher as it got towards the meter than it was back of the purifying boxes, or even just after passing the exhauster. If anyone can put me in the way of reaching a method of making that work satisfactorily I would be very much obliged.

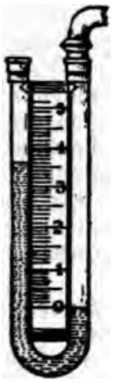

Fig. 5. Adjustable Scale for U-Gauges.

Mr. Tracy—I use a $\frac{3}{8}$-inch pipe, and run-off pipes from that. I have never experienced the least bit of trouble in the years I have used it.

The next Wrinkle read was on an

Adjustable Scale for U-Gauges.—The drawing of this device (Fig. 5) explains itself. I found here quite a loss of water in our gauges during the greater part of the year. To replace the water just to the zero mark is not very convenient, for it is so easy to have not enough or too much water, when the reading is not alike on both sides, and has to be added up. This induced me to use an endless tape running over rollers top and bottom. I adjust the zero mark to the lowest water level, when the highest level gives me the correct reading.

John Gimper.

Galveston, Tex., Feb. 5th, 1895.

DISCUSSION.

Mr. Hinman—I had a pressure gauge prepared like that exactly, and it had the sliding scale, but not the table rest.

The next three Wrinkles read were:

Leveling Street Mains.—Fig. 6 exhibits a method of grading street mains when laying, especially if a dead level has to be maintained. Stakes are driven into the ground to the grade of the top of pipe line, as at x, and at convenient distances apart; of course this is done with a surveyor's level. Three targets are made, a, b and c. Target c is set on top of stake x; the top of this target has a cross-piece upon which is a horizontal line (white on black field) visible to the naked eye from a. Targets a and b are of the same height as c, and are fastened to a collar fitting the top of pipe, as shown in the enlarged view of target, Fig. 7. *y* represents a small pocket spirit-level fastened to target; when set level target with stand plumb. *a* and *b* are fitted just alike; on top of each is a cross-piece, also a nail for sighting. The target *b* is set near the last bell; by looking over the sights from *a* to *c* it will be seen if the bell end of the last joint is too high or too low. It is always best to have the last bell too high, so you can ram it home and thereby get a firm bed for your pipe; in hard ground this is difficult to do, but in our sandy soil here it works splendidly.

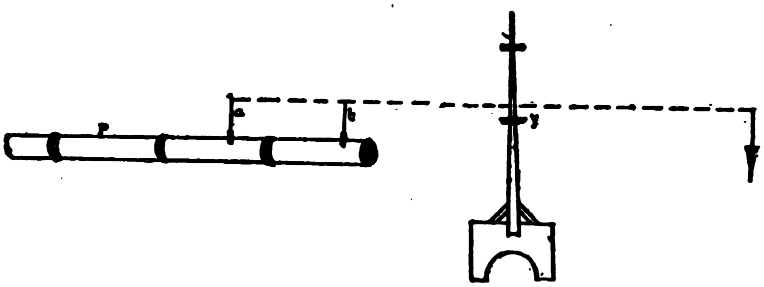

FIG. 6.—Laying Street Mains Level.

FIG. 7.—Target.

Of course, where the grades are pronounced this method will not be needed, but it is very useful where you must lay on a dead level, of which I have a great deal to do here. JOHN GIMPER.

Galveston, Tex., March 5th, 1895.

[A method similar to that of Mr. Gimper, but enabling an absolutely uniform grade to be maintained with *any* desired degree of "fall," was described in the installment of Wrinkles presented before the Association in 1893, and published in *American Gas Light Journal*, June 5th, 1893, p. 816; *Light, Heat and Power*, May, 1893, p. 274; *Progressive Age*, June 1st, 1893, p. 193.—ED.]

Lever for Drawing Bars in Street Work.—The device shown in Fig. 8 is a lever and stand for drawing out a probe when it has been driven into the ground over a gas main in searching for leaks. The lever is about six feet long, made of some strong hard wood, with a hook bolted fast at the larger end to receive a short chain, which is made with a strong ring at one end. About five inches from the larger end of the lever is a ¾ inch hole for the pin which fastens it to the crutch. This crutch is about one foot high, and its prongs have sharp points to keep it from slipping, with a collar about one inch above each point to keep it from pressing too far into the ground when the pressure comes on.

The way I operate it is: After the bar is driven into the ground to loop the chain over the bar close to the ground, then hook it on to the hook at the end of the lever, press down on the lever as it comes up, loosen the lever, and the chain immediately drops on the rod, and you can lift it up a few inches each time. The device is very simple, and operates very quickly. I have used one for three or four years.

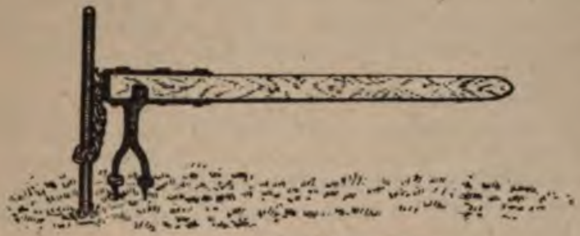

FIG. 8.—Lever for Drawing Bars in Street Work.

Everything will have to be made very strong, as it requires a good deal of pressure to draw a rod out of frozen ground when it is driven in three or four feet. I also find that by heating the bar it will come out of frozen ground much more readily. W. H. ODIORNE.

Springfield, Ill., February 1st, 1895.

A Wrinkle for Service Laying.—The sketch, Fig. 9, illustrates a method of overcoming the difficulty occasioned when a sewer or some similar obstruction is found to be directly in the way of a service pipe or even a small street main. The pipe can be branched and taken both over and under the obstruction, uniting into one again on the other side; the under branch to allow the condensation to flow back to the main, and the upper branch to serve tor the free passage of the gas.

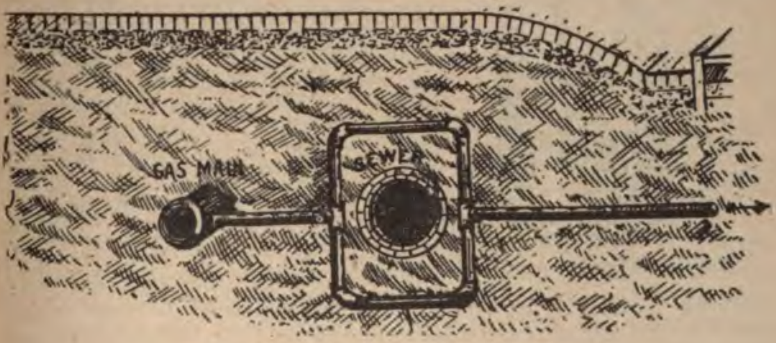

FIG. 9.—Avoiding Obstructions in Service Laying.

HENRY L. DOHERTY. (Communicated by Irvin Butterworth.)

Columbus, O., April 8th, 1895.

DISCUSSION.

Mr. T. D. Miller—Not long ago I used the same scheme with a 4-inch main on an 8-inch sewer, and it worked very satisfactorily.

Mr. Clark—This most admirable device is entirely new to me, and I assume it is new to most of the members. I think it is an excellent device and extremely ingenious. I suppose there is a necessity for some union, and I would like to ask how the connection is really made up and used.

Mr. Butterworth—It is made with a right and left thread.

Mr. Thompson—I might explain that the drawing was made by a gentleman who is decidedly unfamiliar with the gas business.

Mr. T. D. Miller—We have a cast iron pipe, and there is no union necessary there. I made a passage round the sewer in this way with the cast iron pipe and no union.

The next Wrinkle read was on a

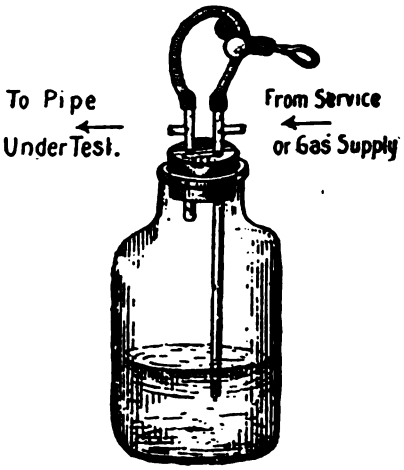

Fig. 10.—Delicate test for piping.

Cheap and Delicate Test for Piping.—The little bottle and its simple attachments, shown in Fig. 10, may be used to test the tightness of house piping, meters, etc., more rigidly than can be done even with a proving pump and mercury gauge. The bottle contains enough water to seal lightly the longer tube or inlet, and to the side openings of the glass tees are connected pieces of rubber hose—that to the inlet tee from a gas supply or a bag to provide a light pressure, and the one from the outlet tee to the piping to be tested. The pinch cock on the rubber tube which by-passes the seal is opened until the pressure from the surface pipe or gas bag has equalized throughout the pipe or vessel under test, and then is closed. If a leak exists in any portion of the work, it must now be supplied through the bottle, and the bubbles from the seal tube are a clear indication.

St. Louis, April 20, 1895. B. E. Chollar.

DISCUSSION.

Mr. Thompson—I have here a model of the device in question, or rather a working bottle. The bottle, as you see, is a very small one. We will suppose that it is desired to test a line of piping in use.

The connection from the chandelier here corresponds to one which would be made from the service pipe. The one at the outlet of the bottle corresponds to the one which would be made to the riser of the house pipe. I will close the end of the pipe in order to prevent the exit of gas, and make a condition similar to that which would exist in tight piping. The pinch cock is set on this part so that the sealed tube is by-passed. When the pressure has thoroughly equalized on both sides of the line the pinch cock is raised. If that pipe is tight no gas will pass through; but if any outlet exists the bubbles will rise through the water. A very minute leak can be in that manner detected. In fact, it is possible with a line of piping to sprinkle water on the pipe and condense the gas to such a degree that a few bubbles will be allowed to pass. It might be well to make that remark as a warning not to be deceived by such appearances as would indicate the existence of a leak, but which were only caused by contraction.

Mr. Thompson then read the following

WRINKLETTES.

A small steam siphon, which may be "home made" by any good mechanic, is very convenient in removing the water from the ashpits of water gas generators.

An excellent mortar for firebrick work where not exposed to the direct impinging action of flame, is made from common clay with just a sufficient proportion of river sand to permit proper handling with a trowel. This will bake hard, and hold tighter than fireclay.

Seal pots are preferable to siphon overflows about a works. In case of a blow out, the former of course reseal themselves as soon as the pressure subsides, while the latter must be shut off and refilled by hand.

The projecting stem of an outside screw gate-valve may be conveniently protected by slipping over it a piece of old rubber hose of proper size. Short pieces of pipe, capped, are sometimes used for the same purpose, but the hose seems preferable.

By mixing a small quantity of melted paraffine with coal tar, a blue-black paint is obtained which holds its gloss better and is much easier of application than without this addition.

Turn steam into the water in holder tanks when the temperature of the surface water is reduced to 40° F. This being approximately the temperature of water at its maximum of density, it is then certain that the entire contents of the tank, clear to the bottom, are equally cold; and with any further reduction of outer temperature the water much more quickly approaches the freezing point.

When laying new mains, before closing in the trench, cut a mark thus ⊢ on the curbstone opposite (say) each fifth bell, to show its location and direction. Where several cement joints are made to one of lead, this mark is best cut opposite the lead joint. The marks are of advantage when barring for leaks. recalking mains, etc., and it is especially convenient to have some such indicator of each dead end for use when extending lines of pipe.

When new buildings are being erected it will pay to get the builder to leave a vertical slit, say 2 inches by twelve inches, for the entrance of the gas service at a proper position in the cellar wall. In cutting out rubble-blocks which lie in the way many an hour is lost by service men, which could be saved, with less damage to foundations, were this device adopted. After completion of the service laying the remainder of the slit may be cemented up. This arrangement is much better than the short piece of pipe sometimes built in, which seldom can be placed at the necessary height or with the proper fall.

A note from Mr. W. A. Aldrich calls attention to the great protection afforded service-pipes by laying them in V or U shaped troughs, filled, after the pipe is laid, with hot pitch, as described in King's Treaties, Newbigging's Hand Book, Colyer's Gas Works, etc.

EDITORIAL NOTE.

At the convention of our Western Gas Association in 1893 the hope was expressed that the institution of this Wrinkle Department "would bring to us as contributors many of our members who have never appeared on the paper lists, yet who could without doubt tell us of valuable contrivances or methods used by them which would be new and serviceable to us, yet which they might not consider sufficient in scope to warrant expansion into a regular paper." As at the inception of any work such as this some initiative is necessary, the budget of items for 1894 and 1895 were practically all obtained by personal solicitation; but it is thought that the plan of the Department should now be sufficiently familiar to bring our members to voluntarily forward suitable contributions for this feature of our meetings. Items may be sent to the Secretary at any time, but will be especially acceptable if received prior to April 1st of each year, which will ensure time for their arrangement and illustration for the convention.

MR. THOMPSON—Since sending the manuscript of the Wrinkle Department to the Secretary, I have received a sketch (see Fig. 11) which practically explains itself. A permanent steel scale is attached to a blast valve standard, showing the opening of the valve in inches. It can be made and fitted by any blacksmith in three hours. It is for attachment to the secondary blast valves on the generator and the by-valves. It is sent by a gentleman who asks that his identity be concealed, and who signs himself "An Admirer of Gas Associations, especially of the Wrinkle Department," from which he has derived much benefit.

MR. RAMSDELL—I move that the hearty thanks of this Association be tendered to Mr. Thompson for his work in connection with the

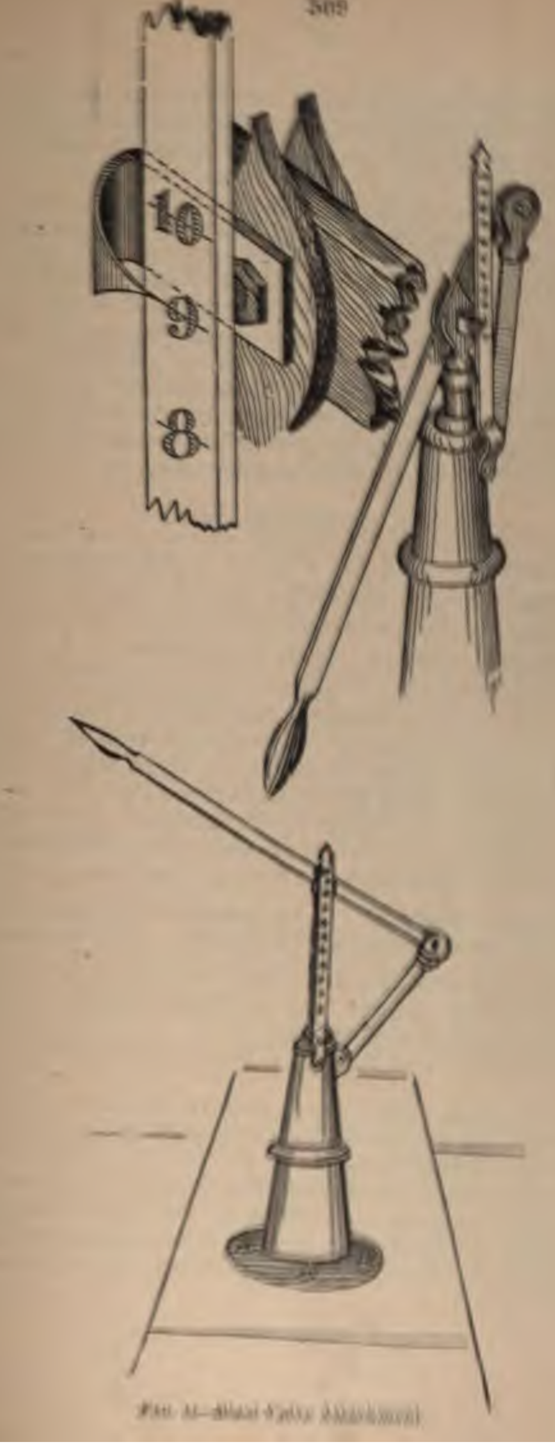

Fig. 11—Blast-Valve Attachment.

Wrinkle Department during the year. I think that department is one of the most interesting features of our Association work, and I think he deserves very great credit for the able manner in which he has filled his position.

Mr. Clark—In seconding Mr. Ramsdell's motion, I want to express my appreciation of the great value of Mr. Thompson's labors. He is practically a paper writer every year. He does much more than his appropriate share of work in the Western Association, and what he gives us is always valuable. I regret that so few members have remained here to enjoy this part of our session, for they have certainly missed a very instructive and interesting half-hour.

Mr. Stratton—Before the motion is put I would like to add that I think it would be well to have this department come up first instead of in the latter part of our meeting, I think it would be a good plan to change it. (The vote of thanks was agreed to.)

THE QUESTION BOX.

The Secretary here read the contents of the Question Box, the questions being asked and answered in the following manner:

1. "*What is the best way to prevent the sweating of show windows of gas lighted storerooms in the winter time?*"

Mr. Gwynn—I have seen a great many experiments tried to prevent show windows from sweating. One way is to close them tightly on the back, so that there is no communication between the window and store, and then perforate the woodwork on the outside, just above the bottom and also at the top of the window, so as to admit and cause a circulation of fresh air in the window. If the window is properly ventilated and a sufficient quantity of air is admitted from the outside, I think there will be no trouble in preventing the sweating.

2. "*Does the candle power of the gas affect the size of the flame, and in what proportion—pressure and burner being the same?*"

Mr. Miller—I think that is a subject on which a paper might be written. It requires a great deal of careful study and experiment, and should not be answered off-hand.

The President—It would take a number of experiments to find out.

Mr. Highlands—If that pressure is heavy it would; but in what proportions? I question whether there is anybody who can give an off-hand answer to that question.

Mr. Humphreys—I question whether anybody could, anyway. It depends entirely upon the constituents of the gas, and the difference in candle power. I would have to study very carefully the conditions before answering. An answer to any particular case would not apply to any other.

[illegible]

4. — [illegible]

5. — [illegible]

Several Members—No.

6. — *What percentage* [illegible]

Mr. Highlands—I move that this be referred to Mr. Thompson's "Wrinkle Department."

7. — *Is the* [illegible] *circumstances?*

Mr. Humphreys—I think we have answered that and shown that we [illegible].

The President—That completes the questions.

Mr. Butterworth—I do not know whether it is the intention that **Mr. Thompson** should be re-appointed editor of the Wrinkle Department each year. If it is necessary, I wish to make that motion.

Mr. S[illegible]—His appointment is for life, I think.

The President—That is so. There is a paper by Mr. Donald **McDonald**, of Louisville, Ky., on "Natural Gas as a Pioneer for Artificial Fuel Gas." He is not here, nor has he appointed anyone to read it. Mr. Case's paper was read by Mr. Cowdery, but in that case I believe he was requested by the writer to read it. What is your pleasure with regard to this paper by Mr. McDonald?

Mr. Thompson—In the absence of Mr. McDonald, I move that we omit the reading, but publish the paper in our proceedings. (Carried.)

The President—I suppose that when that is published it will be clearly stated that the paper was passed without discussion. Is there any other business to come before the Association? Is the Committee on Final Resolutions ready to report?

Mr. Highlands—On behalf of that Committee, although not a member of it, I submit the following resolutions, and move their adoption:

WHEREAS, The 18th annual meeting of the Western Gas Association is about to adjourn, after a most successful and profitable session; and,

WHEREAS, We believe that public and formal acknowledgment should be made by us of our obligations to those who have contributed to its success; therefore,

Resolved, That we hereby express our appreciation and thanks for the efforts that have been so freely and efficiently given in behalf of the success of this meeting, and the pleasure of our members, by the Pittsburgh Gas Companies collectively and by their officers individually; by the exhibitors of gas apparatus who have provided for us a most notable and interesting exhibition of their appliances; by the local manufacturing companies who have co-operated with the Gas Companies in providing social entertainment for our enjoyment; by the Committee of Arrangements; by the Pittsburgh press; and last, but not least, by the officers of the Association, especially by the President and Secretary.

Mr. Morgans seconded the motion of Mr. Highlands, the resolutions were unanimously adopted, and the President declared the business sessions terminated.

NATURAL GAS AS A PIONEER FOR ARTIFICIAL FUEL GAS.

Prepared for the 18th annual meeting of the Association, but not read owing to absence of the author.

BY DONALD MCDONALD, LOUISVILLE, KY.

The above is the title for my paper exactly as it was given to me by the Secretary, and I will try to march according to orders. I would feel easier if the title was simple Natural Gas, as this is a subject on which almost any one can talk indefinitely without saying anything which can be contradicted very positively. It is a most evanescent and illusive subject, as old as the hills, and, as many people remember to their sorrow, the foundation of many booms.

Natural Gas proceeds from many sources, and varies greatly in its qualities. That which comes from Mother Earth consists principally of Carbon and Hydrogen, and is usually impregnated with vapors of petroleum. That which proceeds from "Born Orators" consists largely of other men's ideas, and is usually impregnated with vapors of alcohol.

Natural Gas is for some reason an exceedingly humorous subject. Along with Dynamite, Nitro-Glycerine and mules' heels, it is rarely mentioned without causing that pricking up of the ears which betokens a desire and expectation of being called upon to smile. But this is not the vein in which I have been instructed to treat this subject, so I will attempt at once to get down to business.

Natural Gas has taught thousands of people the inestimable advantages of gaseous fuel, and it is safe to say that having once learned this lesson they will never willingly return to the use of coal. It has also demonstrated the fact that the demand for gas for fuel will be at least ten times that of gas for light. It has also supplied the means for many thousands of very cheap experiments on gas appliances. The net result of which is that these appliances have been improved to such an extent that people can now afford to pay 40 cents a thousand for gas where formerly they found it too expensive at 10 cents a thousand. Of course if artificial gas had attempted to enter the field of domestic heating during the early period of these experiments it would have been impossible either to furnish satisfaction to the consumer or profit to the Company. Now, however, the case is far different. The experiments have been tried, the houses are piped, the connections made, the meters set, and, more than this, the prejudices of the consumers have been overcome, and housewives have learned that a gas fire is less dangerous than a coal fire, and that it means the difference between comfort and drudgery. Any artificial gas company which had attempted to perform this pioneer work in a city as large as Pittsburg would have lost hundreds of thousands of dollars before it had brought the matter to the favorable condition in which it now is.

It is safe to say that if Natural Gas were to fail to-morrow in any city where artificial gas could be had as cheap as 80 cents a thousand, that the demand on the artificial gas would immediately show a marked increase. The kitchens, the bath-rooms, and in many cases the parlors would continue to use the gas stoves which they have already set. If artificial gas could be had as low as 60 cents, we would find added to this list many of the dining rooms, and many bed rooms, which are not used as sitting rooms. Much as has been done, however, there still remains much to be done.

In the first place, artificial gas companies must prepare themselves to sell a good clean gas for fuel at as low a figure as is consistent with a fair profit on their investments, and in arriving at this figure they must leave out of the fund on which interest is to be paid all reference to the fact that iron pipe once cost $100 a ton, that much of it that was laid proved to be useless and had to be replaced, or that opposition companies have been bought out at large cost, and their works allowed to lie idle. I say that these matters must be left out, for the simple reason that while they are burdens on the present companies, they are not burdens on companies which may be organized, and I consider it as certain as anything in business that when Natural Gas fails the demand for artificial gas will be so strong that, unless it is met with an abundant supply at a low price by the old companies, new companies will be formed to meet it.

In figuring on the possibilities of cheap gas in this connection, it must be remembered that all of the items usually included under the head of cost of gas per thousand in the holder, would be considerably reduced if the output of the gas were increased ten-fold. While these items which are included under the head of distribution, general expense, depreciation and management, will be increased very little for the same number of consumers over what they are now, and as a consequence the cost per thousand will be very greatly cut down.

I will not say in this paper how cheap I believe it possible for a large volume of gas for fuel and light to be sold. It is a figure which will vary greatly in each locality, but I do believe that it is possible to bring the figure down so low that the wealthier class of people can afford to use gas to the entire exclusion of coal, while those not so fortunate will find a large use for it in their less constant fires.

Another question. and one not a whit less important than that of the price of the gas, is that of the fixtures through which it shall be burned. If gas at $1 a thousand is burned in a close room without any chimney, the products of combustion escaping into the room, the cost will be so small that coal will not compete with it. Many rooms are heated in just this way, and in cases where they are used for only a few minutes at a time. the plan is not objectionable. Where, however, the fire is in any degree constant, and the room is not ventilated either by lowering a window, or by frequent opening of the door, the walls and windows will become damp, the atmosphere will become oppressive, the health and vigor of the occupant must suffer by it, and either he or his heirs will become firm opponents of gas fuel.

I am aware that certain persons claim that such a fire when burned in a particular patented appliance, not only does not injure the atmosphere of the room, but that it actually purifies it. They even go so far as to state in a published pamphlet, that a cubic foot of gas requires for its combustion 15 cubic feet of air, and that 15 cubic feet of fresh air are drawn in to take its place, forgetting entirely the fact that the nitrogen, carbonic acid and watery vapor remaining from the combustion exceed in weight, and very near equal in volume, the air that has been used for combustion. Forgetting also the fact, that six feet of air will furnish sufficient oxygen to burn one cubic foot of coal gas.

In the same pamphlet occurs the startling statement that 6 per cent. of gas is mixed with 94 per cent. of air, thus "greatly intensifying the heat evolved." Of course, every gas engineer knows that such a mixture would be too poor to explode, much less burn. In the same pamphlet I find the no less remarkable statement that the combustion of 25 cubic feet of illuminating gas will produce only 8½ feet of carbonic acid, which amount they say is, "of course, negligible." A very little figuring will show that the amount of carbonic acid gas actually produced is nearly twice as large as stated above, and in view of the fact that most dwelling rooms contain hardly more than 2,000 cubic feet of space, one does not feel like admitting that the charging of this atmosphere with 20 feet of carbonic acid gas per hour, for ten hours in succession, would be negligible. On the contrary, it is theoretically damnable, and practically gives a heavy compressive atmosphere.

The fact that such advertising matter has been presented year after year to gas men, and to gas associations, without having been publicly challenged, shows how little interest gas managers have taken in this most important subject.

Among the manufacturers of gas appliances all these chemical calculations seem to have been left entirely to the sheet-iron worker, and as a result we see on the market appliances for burning gas which are scientifically bad, and practically still worse. Many of them have nothing to recommend them except the nickel-plate and glass jewels. I do not wish to be understood as saying that all of the gas appliances have been conceived in ignorance, and brought forth in indifference; on the contrary, if it were not for the rules of this Association, which forbid the mention of particular concerns, I would call attention to a cooking stove and a gas radiator which have recently appeared on the market, and which are distinct advances on all former appliances of their kind, in that they allow none of their products of combustion to escape into the rooms.

I have wandered somewhat from the subject of my article, but I consider the question of good, economical and healthful gas appliances to be the most important one connected with the general use of gas as fuel, and I do not think it possible to call the attention of gas managers too strongly to the fact. The public must necessarily look to them for guidance in this matter.

The manufacturers (human as they are) will make whatever will sell most readily, and the consumers of gas are almost invariably ignorant of its chemical composition and the scientific laws of its combustion. They have a right to look to the gas companies for guidance in this matter, and when they invest their money in a useless appliance, or when they find their health injured by the use of a badly designed one, you can be quite sure, not only that the blame will rest on the gas company, but that the pecuniary loss will fall in the same place.

About one year ago I prepared a paper on the subject of "Gas for Fuel," and read it before the Ohio Gas Light Association. It contains some rather elaborate calculations of the heating effect and the products of combustion of gas fires, and to those who are interested in this part of the subject, I would refer them to this paper, rather than reproduce the figures. In the same paper I have also gone over the various substances from which gas can be made and the cost per million heat units in the gas made from each of these substances. With the result that gas from naphtha will cost 30 cents for each million heat units exclusive of labor and other items. Gas from coke will cost 19 cents per million heat units, while the gas from soft coal at $1.50 a ton, will cost only 8.9 cents per million heat units. These figures leave no escape from the conclusion that when gas is made at a price low enough to be sold as a general heating agent, it will be made from soft coal, and may or may not be enriched with crude oil or naphtha. Exactly by what process the gas is to be made will probably not be determined for several years to come. I believe, however, that the process which first drives off the bitumen from the coal in the shape of coal gas, and then makes water gas out of the residual coke, will be the most economical and the most convenient, especially when we remember that the only other plan is to make coal gas from the bitumen in the coal, and then sell the resulting coke, tar and ammonia.

The great bulk of the capital of a gas company is, however, invested in mains, holders and meters, and the fact is plain that it is no better fixed to handle and sell coke, tar and ammonia than another concern would be with one-tenth of their investment. We are, therefore, driven to the conclusion that that process is best for the gas company which turns the largest proportion of the coal into gas, and leaves the fewest residuals.

Another problem that natural gas has solved, is the fluctuations which may be expected in the demand for fuel gas between winter and summer, and between day and night. It is not my intention to enter into this subject much in detail, but I believe from my own experience that these fluctuations are so enormous that they must be met by a large generating capacity rather than by large holders. I do not mean to say that large holders would not be an advantage; but when we remember that 10,000 consumers would call for 1,500,000 feet of gas per hour, and during intensely cold weather would keep this demand up for an average of 16 hours a days, we see that during a cold spell lasting 30 days, there would be no opportunity to refill the mammoth gas holders, which would be required, and that we must depend on making the gas as rapidly as it is called for, and use a pattern of generator which can be blown into service in a short time without injury, and can be left to cool down again when not required.

Another very important feature of this question is the fact that if everyone depended on gas alone for heat, the consequences of a short supply would be even more disastrous than in the case of gas used for light. In bitter weather the demand is enormous, and the short supply will come at the very time when the consequences are most bitterly felt. I think it most important, therefore, that all companies supplying gas for fuel should urge their consumers to keep on hand a small supply of coal, and be ready to burn it in case of emergency. By doing so, the customers will not only keep warm themselves, but they will leave the gas for others who are less fortunately situated.

I am neither a prophet nor the son of a prophet, but I venture to say that the time will come when the houses will be equipped with fixtures which will burn either coal or gas. If this was done, gas at a comparatively high price would be an economical fuel in mild weather, and at all times an economical kindling for the coal. The coal, however, would be on hand when the weather had settled down to continuous cold, and would not only furnish a reliable fire for the people, but would relieve the companies from the necessity of carrying such enormous reserves. At the same time it would prevent the gas from appearing as expensive as it does when burned constantly during intensely cold weather.

Assuming that natural gas has opened a way for the general use of artificial gas as a domestic fuel, three questions arise: First, How will this change come about? Second, When will it come? Third, What can gas companies do to hasten it?

In reply to the first question I will say that the change will come by the gradual use of artificial gas as a supplement to natural gas when the days are cold and the supply insufficient. We have already done this in Louisville with perfectly satisfactory results, and I am informed that several large natural gas companies are preparing to do the same thing in other cities.

The natural gas will gradually fail, and the proportion of artificial gas sold will gradually increase, until finally the people will find that they are burning artificial gas entirely. As soon as this is shown to be profitable (which it will be), cities that never had natural gas will take it up, and either through their present gas companies or through opposition gas companies will supply this demand.

As to the question "when," it will take a great many years before gas fuel is generally used as gas light is now. At the same time we must not lose sight of the fact that more has been done in this direction in the last three years than was done in the hundred years which preceded.

Replying to the third question, I will say that the artificial gas companies can begin selling gas for fuel at a very moderate profit, say twice the cost in the holder, exclusive of interest. In this way they would accommodate their patrons, and lay the two ghosts which continually trouble their dreams, that is, "municipal control" and "the prospect of an opposition company."

Another thing they can do, and one equally important, is to take lively interest in all substantial improvements in gas-burning appliances, and see that their customers get the best and the most economical.

I predict that those companies which adopt this line of tactics will come eventually to consider that natural gas has been to them a very good friend in a very complete disguise.

APPENDIX.

OFFICERS

OF THE

WESTERN GAS ASSOCIATION,

1895-1896.

President.

A. W. LITTLETON................Quincy, Ill.

First Vice-President.

W. H. ODIORNE...............Springfield, Ill.

Second Vice-President.

S. M. HIGHLANDS...............Clinton, Iowa.

Secretary and Treasurer.

JAS. W. DUNBAR.............New Albany, Ind.

Editor Wrinkle Department.

GEO. TREADWAY THOMPSON.....New York City.

DIRECTORS.

I. C. BAXTER, *Ex-Officio.*

WM. MCDONALD..........	Albany, N. Y.......	Term	expires	1896
GEO. TREADWAY THOMPSON.	New York City......	"	"	1896
IRVIN BUTTERWORTH.......	Columbus, O.......	"	"	1896
WM. M. EATON...........	Jackson, Mich......	"	"	1896
GEO. H. HARPER..........	Altoona, Pa........	"	"	1897
PETER YOUNG.............	Halifax, N. S......	"	"	1897
O. O. THWING............	St. Louis, Mo......	"	"	1897
WM. STEINWEDELL.........	Quincy, Ill........	"	"	1897

PAST PRESIDENTS.

*J. O. KING	1878–79–80
*THOMAS BUTTERWORTH	1881–82
J. B. HOWARD	1883–84
T. G. LANSDEN	1885
JAMES SOMERVILLE	1886
*JOHN FULLAGAR	1887
EMERSON McMILLIN	1888
GEORGE G. RAMSDELL	1889
*E. J. KING [Elected for	1890
CHARLES R. FABEN, JR	1890
FREDERICK EGNER	1891
E. G. COWDERY	1892
B. E. CHOLLAR	1893
E. H. JENKINS	1894
ISAAC C. BAXTER	1895

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*Deceased.

PAST SECRETARIES.

LEE A. HALL	1878–82
A. W. LITTLETON	1882–94

LIST OF MEMBERS.

HONORARY MEMBERS.

Joseph Russell Thomas.......... May, 1884
Editor *American Gas Light Journal*, New York, N. Y.

A. B. Slater.......... May, 1886
Treasurer and General Manager Providence Gas Co., Providence, R. I.

John P. Harbison.......... May, 1886
Treasurer and General Mgr. Hartford City Gas Light Co., Hartford, Conn.

Austin C. Wood.......... May, 1886
Engineer and Superintendent Gas Light Co., Syracuse, N. Y.

William Henry White.......... May, 1887
Constructing Engineer, 32 Pine Street, New York, N. Y.

C. J. R. Humphreys.......... May, 1887
Agent Lawrence Gas Co., Lawrence, Mass.

Prof. T. C. Mendenhall.......... May, 1888
Superintendent United States Coast Survey, Washington, D. C.

Andrew Hickenlooper.......... May, 1889
President Cincinnati Gas Light and Coke Co., Cincinnati, O.

Henry B. Leach.......... May, 1890
Agent and Treasurer Taunton Gas Co., Taunton, Mass.

Forrest E. Barker.......... May, 1891
Pres. Mass. Board of Gas and E. L. Com'rs, 13 Beacon St., Boston, Mass.

ACTIVE MEMBERS.

Addicks, W. R .... May, 1895
Engineer Boston Gas Co., Boston, Mass.

Averill, A. T .... May, 1879
President and Treasurer Gas Co., Cedar Rapids, Iowa.

Averill, G. M .... May, 1893
Secretary Gas Co., Cedar Rapids, Mich.

Barrett, A. H .... May, 1879
Vice-President and Engineer Louisville Gas Light Co., Louisville, Ky.

Bauer, Peter .... May, 1890
Superintendent Gas Co., Texarkana, Ark.

Baxter, Isaac C .... May, 1885
Engineer and Superintendent Detroit Gas Co., Detroit, Mich.

Beal, Wm. R .... May, 1892
President and Superintendent Central Gas Light Co., 142d St. and Alexander Avenue, New York, N. Y.

Bivings, F. L .... May, 1892
Secretary and Treasurer Birmingham Gas Co., Birmingham, Ala.

Blinks, W. M .... May, 1895
Assistant Superintendent Gas Co., Michigan City, Ind.

Blodget, Charles W .... May, 1890
Secretary Williamsburg Gas Light Co., 324 Bedford Avenue, Brooklyn, E. D., N. Y.

Boardman, A. E .... May, 1887
President Macon Gas Light and Water Co., Residence Brevard, N. C.

Boaz, O. T .... May, 1890
Owner Gas Works, Pittsburg, Kans.

Bolcom, H. C .... May, 1888
Secretary and General Manager Gas Co., Winona, Minn.

Branch, A. H .... May, 1892
General Manager Denver Consolidated Gas Co., Denver, Colo.

Brown, Geo. H .... May, 1890
Superintendent Gas Light Co., Morristown, N. J.

Brown, Walter Lee .... May, 1889
Secretary and Treasurer Northwestern Gas Light and Coke Co., Evanston, Ill.

Buck, Earle H .... May, 1891
Superintendent Citizens' Gas Light Co., Vincennes, Ind.

Bushnell, A. S .... May, 1883
President Gas Co., Springfield, O.

Butterworth, Irvin .... May, 1890
Vice-President and General Manager Columbus Gas Light and Coke Co., Columbus, O.

Byers, C. A .... May, 1895
Engineer Bristol Gas Co., Haversford, Pa.

Byrne, F. P .... May, 1892
Vice-President and General Manager Detroit Gas Co., Detroit, Mich.

Byron, Timothy .... May, 1890
Superintendent Gas Co., Birmingham, Ala.

Calhoun, Robert .... May, 1892
Superintendent Bay City Gas Light Co., Bay City, Mich.

Cardall, J. H .... May, 1894
Superintendent Gas Co., Memphis, Tenn.

Cathels, D. M .... May, 1891
Louisville Gas Light Co, Louisville, Ky.

Cathels, E .... May, 1890
Superintendent Gas Co., Butte, Montana.

Chollar, B. E .... May, 1884
Engineer Laclede Gas Light Co., 411-413 North Eleventh Street, St. Louis, Mo.

Christie, W. H. .... May, 1892
Superintendent Corning Gas Company, Corning, N. Y.

Clark, Walton .... May, 1885
General Superintendent United Gas Improvement Co., Philadelphia, Pa.

Clary, E. D .... May, 1890
Secretary and Superintendent Gas Company, Burlington, Iowa.

Collins, Carroll .... May, 1883
Secretary and Treasurer Green Bay Gas Light Co., Green Bay, Wis.

Copley, I. C .... May, 1892
Superintendent and Manager Aurora Gas Light Co., Aurora, Ills.

Corley, J. A .... May, 1891
Superintendent Gas Company, Owensboro, Ky.

Corscot, John .... May, 1892
Secretary and Treasurer Madison City Gas Light and Coke Company, Madison, Wis.

Coverdale, R. T .... May, 1883
Gas Engineer, 15 East Third Street, Cincinnati, Ohio.

Cowdery, E. G .... May, 1885
Engineer and Superintendent Gas Co., Milwaukee, Wisconsin.

Cowdrey, R. E .... May, 1893
Assistant Superintendent Gas Co., Topeka, Kansas.

Croul, Jerome .... May, 1888
Trustee of Detroit Gas Co., Detroit, Mich.

[illegible], J. R. .... May, 1891
Superintendent Gas Co., Denison, Texas.

[illegible] .... May, 1890
Superintendent Gas Co., Wheeling, W. Va.

[illegible] Lane .... May, 1881
Superintendent Gas Co., Iowa City, Iowa.

Davis, S. S .... May, 1890
Secretary and Superintendent People's Light and Fuel Mfg. Co., Moline, Ills.

Dean, Frank M .... May, 1890
Secretary and Superintendent Gas Co., Jacksonville, Ills.

Douglas, H. W .... May, 1889
Treasurer and Superintendent Gas Co., Ann Arbor, Michigan.

Dunbar, C. H .... May, 1893
Superintendent Gas Co., Elgin, Ills.

Dunbar, James W .... May, 1883
Superintendent Gas Co., New Albany, Ind.

Dunlap, H .... May, 1887
Treasurer Gas Co., Emporia, Kansas.

Dunlevy, H. H .... May, 1893
President Board of Gas Trustees, Wheeling, W. Va.

[illegible], J. A .... May, 1893
Engineer Pintsch Compressing Co., 160 Broadway, N. Y.

Eaton, W. M .... May, 1888
Superintendent Jackson National Gas and Fuel Co., Jackson, Michigan.

Egner, Frederick .... May, 1884
Superintendent Gas Co., Norfolk, Va.

Elbert, V. L .... May, 1884
Kentucky Heating Co., Louisville, Ky.

Elwood, J. G .... May, 1892
Secretary and Managing Director Joliet Gas Light Co., Joliet, Ills.

Evans, Charles H .... May, 1889
Engineer Mutual Gas Fuel Co., Chicago, Ills.

Faben, Charles R., Jr .... May, 1885
Superintendent Toledo Gas Light and Coke Co., Toledo, Ohio.

Faux, J. A .... May, 1892
Superintendent South Side Gas Co., Pittsburgh, Pa.

Felt, Henry .... May, 1892
Superintendent Distribution Cincinnati Gas Light and Coke Co., Cincinnati, Ohio.

Ferrier, James .... May, 1889
Assistant Superintendent Gas Co., Columbus, Ga.

Finnegan, Arthur.......May, 1893
Superintendent Station A, Laclede Gas Works, St. Louis, Missouri.

Fitch, Henry D.......May, 1894
General Manager Gas Co., Bowling Green, Ky.

Fitz, Robert F.......May, 1890
Elgin, Illinois.

Forbes, James.......May, 1891
Superintendent Gas Co., Chattanooga, Tenn.

Forstall, A. E.......May, 1888
Newark Gas Light Co., Newark, N. J.

Freeze, F. W.......May, 1888
Superintendent Gas Co., La Porte, Ind.

Frost, W. H.......May, 1893
President Gas Co., Fort Scott, Kas.

Fullagar, W. E.......May, 1889
Manager Gas Co., Port Jervis, N. Y.

Fullerton, George, Jr.......May, 1894
Assistant Superintendent, 545 Elk Street, Buffalo, New York.

Gerould, H. T.......May, 1879
Superintendent Gas Co., Centralia, Ills.

Gimper, John.......May, 1879
Engineer and Superintendent Gas Co., Galveston, Texas.

Glasgow, A. G.......May, 1889
Of Humphrey & Glasgow, 9 Victoria Street, London, S. W., England.

Goldsmith, William G.......May, 1894
Assistant Secretary Detroit Gas Co., Detroit, Michigan.

Greenough, M. S.......May, 1893
Vice President and General Manager Cleveland Gas Light Co., Cleveland, Ohio.

Gwynn, Jos.......May, 1888
Superintendent Gas Co., Steubenville, Ohio.

Harris, William H.......May, 1894
Assistant Superintendent Gas Co., Mansfield, Ohio.

Harper, George H.......May, 1890
Superintendent Gas Co., Altoona, Pa.

Harris, George S.......May, 1883
Superintendent Gas Co., Mansfield, Ohio.

Hathaway, E. C.......May, 1894
Superintendent Gas Co., Frankfort, Ky.

Hill, William H.......May, 1894
Superintendent Gas Co., Erie, Pa.

Hess, Charles E.................................May, 1887
Secretary, Treasurer and Superintendent, Jefferson City Light, Heat and Power Co., Jefferson City, Mo.

Highlands, S. M.................................May, 1892
Superintendent Clinton Gas Light and Coke Co., Clinton, Iowa.

Holmes, B. P.................................May, 1894
General Manager Gas Co, Youngstown, Ohio.

Hopper, W. H.................................May, 1887
American Meter Co., Philadelphia, Pa.

Howard, J. B.................................May, 1879
Manager Gas Light Co., Galena, Ills.

Howden, J. J.................................May, 1880
Treasurer and Superintendent Gas Co., Muskegon, Mich.

Humphreys, Alex C.................................May, 1892
Humphreys & Glasgow, Manhattan Life Building, 64 Broadway, N. Y.

Hyde, Eugene A.................................May, 1894
Superintendent Gas and Electric Light Co., Ravenna, O.

Hyde, Gustavus A.................................May, 1880
Engineer Cleveland Gas Light and Coke Co., Cleveland, O.

Hyde, Henry H.................................May, 1888
Engineer and Superintendent East Saginaw Gas Co., East Saginaw, Mich.

Jenkins, E. H.................................May, 1885
Superintendent Gas Light Co., Columbus, Ga.

Johnson, W. J.................................May, 1888
General Manager Gas Co., Fort Smith, Ark.

Jones, C. D.................................May, 1888
President Fremont (Neb.) Gas and Electric Light Co.;
Residence, Independence, Iowa.

Jones, Edward C.................................May, 1891
Gas Engineer San Francisco Gas Light Co., San Francisco, Cal.

Jones, T. C.................................May, 1895
Superintendent Gas Co., Delaware, O.

Judge, W. H.................................May, 1881
Secretary Treasurer and Superintendent Rock Island Gas Co., Rock Island, Ills.

Keenan, N. G.................................May, 1889
Engineer and Assistant to the President, Cincinnati Gas Light and Coke Co., Cincinnati, O.

Keller, C. M.................................May, 1881
Secretary, Superintendent and General Manager Gas Co., Columbus, Ind.

Kennedy, J. M.................................May, 1881
Gas and Steam Fitter, 116 North Main Street, Rockford, Ills.

Knight, Charles S. .... May, 1884
Fort Wayne, Ind.

Knight, J. J .... May, 1894
Manager Gas Co., Kalamazoo, Mich.

Kuehn, J. L .... May, 1895
Superintendent Gas Co., York, Pa.

Lane, F. K. .... May, 1895
Superintendent Calumet Gas Co., Chicago, Ills.

Lansden, Thomas G. .... September, 1878
Consulting Gas Engineer, Security Building, St. Louis, Mo.

Light, George .... May, 1888
Assistant Superintendent Gas Co., Dayton, O.

Light, Joseph .... May, 1883
Superintendent Gas Co., Dayton, O.

Littleton, A. W. .... September, 1878
Secretary and Superintendent Quincy Gas Light and Coke Co.,
Quincy, Illinois.

Logan, John D. .... May, 1894
Vice-President Newtown Gas Co., Newtown, N. Y.

Lukins, W. H. .... May, 1892
Manager Streator Gas and Light Co., Streator, Ills.

Lynn, John R. .... May, 1894
Superintendent Gas Co., Penn Yan, N. Y.

Lynn, J. T .... May, 1889
Superintendent of Distribution, Gas Co., Detroit, Mich.

Malin, H. A. .... May, 1893
Secretary Gas Co., Joplin, Mo.

MacKay, Charles .... May, 1888
Superintendent Gas Co., Watertown, Wis.

McAdam, B .... May, 1895
Superintendent Gas Co., Michigan City, Ind.

McClary, N. A. .... May, 1885
President Gas Co., Cicero, Ills., 218 LaSalle Street, Chicago.

McDonald, William .... May, 1883
D. McDonald & Co., Albany, N. Y.

McIlhenny, J. D .... May, 1895
Manager Portsmouth, Va., Gas Co.; Residence Philadelphia, Pa.

McKay, William E. .... May, 1892
Assistant Engineer Bay State Gas Co., Boston, Mass.

McMillan, George .... May, 1885
Secretary, Treasurer and General Manager Gas Co., La Crosse, Wis.

McMillin, Emerson ....May, 1883
President Laclede Gas Light Co. Office 40 Wall Street, New York, N. Y.

Miller, Alten S ....May, 1890
Superintendent East River Gas Co., Long Island City, New York.

Miller, C. R ....May, 1891
200 Times Building, Pittsburg, Pa.

Miller, Thomas D ....May, 1893
General Manager Gas Co., Dallas, Texas.

Morrill, E. E ....May, 1890
General Manager Gas Co., Cicero, Ills.

Mitchell, K. M.......................................May, 1889
Superintendent St. Joseph Gas and Manufacturing Co., St Joseph, Mo.

Montgomery, James.................................May, 1881
Superintendent Gas Co., Sedalia, Mo.

Morgans, William H ....May, 1884
Secretary and Superintendent Gas Co., Pontiac, Michigan.

Murdock, George T.................................May, 1884
Secretary and Superintendent Gas Co., Elkhart, Ind.

Murdock, James W ....May, 1886
Secretary and Superintendent Gas Co., Ottawa, Ills.

Nash, A. F...May, 1894
Secretary and Treasurer Gas Co., Windsor, Ontario.

Odiorne, William H.................................May, 1884
Superintendent Gas Co., Springfield, Ills.

Payne, M. J...May, 1884
President Kansas City Gas Light and Coke Co., Kansas City, Missouri.

Page, Carter H., Jr ....May, 1894
813 Drexel Building, Philadelphia, Pa.

Penn, Jerome...May, 1890
Superintendent Gas Co., Washington C. H., Ohio.

Perkins, B. W ....May, 1880
Superintendent Gas Co., South Bend, Ind.

Post, I. S ....May, 1889
Secretary and Treasurer Gas Co., Chattanooga, Tenn.

Powell, W. E ....May, 1894
Superintendent Gas Co., Logansport, Ind.

Powell, Charles S....................................May, 1891
Secretary Richmond Water and Light Co., Richmond, Kentucky.

Pratt, E. G...May, 1888
Manager Capital City Gas Light Co., Des Moines, Iowa.

Printz, Eugene..May, 1883
Superintendent Gas Co., Zanesville, Ohio.

Ramsdell, George G . . . . May, 1879
General Manager American Gas Co., 222 South Third Street, Philadelphia, Pa.

Rathell, W. S . . . . May, 1893
Superintendent Gas Co., Cairo, Ills.

Raynor, Charles H . . . . May, 1880
Superintendent Adrian Gas Co., Adrian, Michigan.

Rice, Elihu S . . . . May, 1879
Secretary, Treasurer and General Manager Gas Co., Logansport, Ind.

Ridgely, Edward . . . . May, 1891
Secretary Gas Co., Springfield, Ills

Ridgely, William . . . . May, 1888
President Gas Co., Springfield, Ills.

Rodgers, John W . . . . May, 1892
Manager Racine Gas Light Co., Racine, Wis.

Rowe, J. J . . . . May, 1890
Superintendent Gas Works, Newark, N. J.

Ross, Alex . . . . May, 1890
Secretary and General Manager Laclede Gas Light Co., 411-413 North Eleventh Street, St. Louis, Mo.

Runner, Z. T . . . . May, 1882
General Manager Gas Co., Freeport, Ills.

Russell, C. P . . . . May, 1891
245 Broadway, N. Y.

Salter, James . . . . May, 1894
Superintendent Gas Co., Covington, Ky.

Seamon, J. F . . . . May, 1895
Superintendent United Light Co., Uniontown, Pa.

Sellers, W. B . . . . May, 1889
Secretary Gas Co., Covington, Ky.

Shelton, F. H . . . . May, 1889
United Gas Improvement Co., Drexel Building, Philadelphia, Pa.

Shores, L. W . . . . May, 1887
Superintendent Gas Co., Kankakee, Ills.

Slater, A. B., Jr . . . . May, 1894
Superintendent Gas Co., Providence, R. I.

Small, J. C . . . . May, 1889
Secretary and Treasurer Gas Co., Aurora, Ind.

Soden, W. T . . . . May, 1887
President Gas Co., Emporia, Kansas.

Somerville, James . . . . May, 1880
Engineer and Superintendent Indianapolis Gas Light and Coke Co., Indianapolis, Ind.

Spencer, R .... May, 1879
President Gas Co., Burlington, Iowa.

Starr, James M .... May, 1879
Vice-President Gas Co., Richmond, Ind.

Steinwedell, William .... May, 1887
President Quincy Gas Light and Coke Co., Quincy, Ills.

Stiles, A. K .... May, 1892
President Streator (Ills.) Gas and Light Co., Office 125 LaSalle Street, Chicago, Ills.

Stratton, J. W .... May, 1887
General Manager Gas Co., Valparaiso, Ind.

Stratton, R. J .... May, 1888
Superintendent Gas Co., Decatur, Ills.

Swann, Harry R .... May, 1891
Inspector Gas Co., Louisville, Ky.

Tayler, George H .... May, 1883
Secretary, Treasurer and Superintendent Gas Co., Warren, O.

Thompson, George Treadway .... May, 1888
Superintendent Station B, Laclede Gas Light Co., Main and Howard Streets, St. Louis, Mo.

Thompson, J. D .... May, 1885
Treasurer Laclede Gas Co., 411-413 North Eleventh Street, St. Louis, Mo.

Thwing, O. O .... May, 1893
Superintendent Gas Works, Milwaukee, Wis.

Tracy, William .... May, 1887
Superintendent Light and Heating Co., Leavenworth, Kansas.

Turner, Thomas .... May, 1891
President and General Manager Gas Co., Charleston, South Carolina.

Walbridge, H. D .... May, 1889
Secretary, Treasurer and General Superintendent Gas Co., Grand Rapids, Mich.

Walker, Joseph .... May, 1892
Superintendent Port Huron Gas Light Co., Port Huron, Michigan.

Wallace, William .... September, 1878
President and Superintendent Gas Co., Lafayette, Ind.

Ward, Benjamin A .... May, 1890
Michigan City, Ind.

Warmington, D. R .... May, 1891
Engineer People's Gas Co., Cleveland, O.

Watt, Anthony .... May, 1886
General Manager and Purchasing Agent Gas Co., Connersville, Ind.

Watts, Sylvester ....September, 1878
President Rock Island (Ills.) Gas Co. Office 904 Olive Street, St. Louis, Mo.

Wescott, J. T ....May, 1894
Consulting Engineer, Belleville Gas Co., Toronto, Ont.

Whipple, H. S,....................................May, 1888
Manager Rockford American Gas Co., Rockford, Ills.

Whysall, G. H ....May, 1895
Superintendent Miami Gas & Fuel Co., Dayton, O.

Wilkiemeyer, H ....May, 1889
Vice-President and General Manager Evansville Gas and Electric Light Co., Evansville, Ind.

Williams, C. M....................................May, 1891
Terre Haute Gas Co., Terre Haute, Ind.

Williams, William.................................May, 1892
Manager Sarnia Consumers' Gas Co., Sarnia, Ont.

Williamson, John ....May, 1891
Assistant Engineer People's Gas Co., Chicago, Ills.

Wilson, W. M......................................May, 1890
Superintendent Garland Gas Light Co., Hot Springs, Ark.

Woods, George E...................................May, 1892
Assistant Superintandent Standard Gas Light Co., New York, N. Y.

Woodward, R.......................................May, 1893
Superintendent Gas Co., New Rochelle, N. Y.

Young, John.......................................May, 1892
Superintendent Allegheny Heating Co., Allegheny City, Pa.

Young, Peter ....May, 1892
Superintendent Gas Co., Knoxville, Tenn.

Young, Robert ....May, 1892
Superintendent Allegheny Gas Co., Allegheny City, Pa.

Young, Robert, Jr ....May, 1892
Assistant Superintendent Detroit Gas Light Co., Detroit, Mich.

Yuille, George A..................................May, 1890
Chicago, Ills.

ASSOCIATE MEMBERS.

Adam, Charles F . . . . May, 1887
Manager Salesman Geo. M. Clark & Co., Chicago, Ills.

Bingham, S. H. . . . . May, 1890
Secretary Samuel E. Barrett Mnfg. Co., 70 LaSalle Street, Chicago, Ills.

Birch, T. H . . . . May, 1883
Assistant Manager Stacey Mnfg. Co., Cincinnati, O.

Bissell, W. G . . . . May, 1891
With George M. Clark & Co., Manufacturers Gas Stoves, Chicago, Ills.

Bradley, Carl D . . . . May, 1886
President Bouton Foundry Co., Chicago, Ills.

Bredel, Fred. . . . . May, 1889
Gas Engineer, 118 Farwell Avenue, Milwaukee, Wis.

Brown, E. C. . . . . May, 1887
Publisher *Progressive Age*, 18 Broadway, New York, N. Y.

Buss, Julius. . . . . May, 1890
Engineer, Agent Fred Bredel, 22 Beaver Street, New York, N. Y.

Callendar, E. P . . . . May, 1894.
***American Gas Light Journal*, 32 Pine Street, New York City.**

Collins, D. J. . . . . May, 1895
Agent United Gas Improvement Co., Chicago, Ills.

Cressler, A. D . . . . May, 1880
Engineer Kerr Murray Mnfg. Co., Fort Wayne, Ind.

Dell, John. . . . . September, 1878
Agent Laclede Fire Brick and Mnfg. Co., 901 Pine Street, St. Louis, Mo.

Dickey, Charles H. . . . . May, 1883
Maryland Meter and Mnfg. Co., Baltimore, Md.

Dickey, George S . . . . May, 1887
Foreman Maryland Meter and Mnfg. Co., Baltimore, Md.

Dickey, P. S. . . . . May, 1889
Western Agent Maryland Meter and Mnfg. Co., 122 and 124 Michigan Street, Chicago, Ills.

Ellsworth, F. O. . . . . May, 1895
Salesman F. O. Ellsworth Coal Co., Chicago, Ills.

Felt, Henry, Jr. . . . . May, 1892
Agent American Meter Co., 177 Elm Street, Cincinnati, O.

Floyd, Fred W. . . . . May, 1899
Oregon Iron Works, 539 West Twentieth Street, New York, N. Y.

Gardner, James, Jr . . . . May, 1894
Gardner Retort and F. B. Co., Pittsburg, Pa.

Gassett, A. L .... May, 1894
Schneider, Trenkamp Co., Cleveland, O.

Goodwin, W. W .... May, 1884
President Goodwin Gas Stove and Meter Co., 1012-1018 Filbert Street, Philadelphia, Pa.

Graeff, George W., Jr .... May, 1886
Editor *Light, Heat and Power*, P. O. Drawer 1576, Philadelphia, Pa.

Green, James .... September, 1878
President Laclede Fire Brick Mnfg. Co., 901 Pine Street, St. Louis, Mo.

Gribbel, John .... May, 1890
Agent John J. Griffin & Co., 52 Dey Street, New York, N. Y.

Guilford, A. J .... May, 1893
With National Tube Works Co., Chicago, Ills.

Guldlin, O. N .... May, 1888
President Western Gas Construction Co., Fort Wayne, Ind.

Harper, H. D .... May, 1886
Manager Chicago Branch D. McDonald & Co., 34-36 West Monroe Street, Chicago, Ills.

Harris, Andrew .... May, 1890
Harris Bros. & Co., Twelfth and Brown Streets, Philadelphia, Pa.

Harris, Joseph A .... May, 1883
Harris Bros. & Co., Twelfth and Brown Streets, Philadelphia, Pa.

Hauk, Charles D .... May, 1884
Vice-President and General Manager National Heat and Power Construction Co., Philadelphia, Pa.

Hayward, S. F .... May, 1891
Treasurer and Manager Connelly Iron Sponge and Governor Co., 111 Broadway, New York, N. Y.

Helme, Wm. E .... May, 1889
Helme & McIlhenny, 1339 Cherry Street, Philadelphia, Pa.

Henderson, E. H .... May, 1895
Agent James Gardner, Jr., Pittsburgh, Pa.

Hinman, C. W .... May, 1894
With N. Tufts, 153 Franklin Street, Boston, Mass.

Higgins, C. M .... May, 1890
With Standard Oil Co., 26 Broadway, New York, N. Y.

Isbell, Charles W .... May, 1894
Isbell-Porter Co., 245 Broadway, New York City.

Keeler, H. E .... May, 1893
With National Tube Works Co., Chicago, Ills.

Kendall, J. R .... May, 1892
Builder of Gas Works, Terre Haute, Ind.

Kirby, H. C .... May, 1895
Coal Dealer, Cleveland, O.

Logan, William J .... May, 1891
Proprietor Logan Iron Works, Brooklyn, E. D., N. Y.

Long, John .... May, 1880
Traveling Agent Dennis Long & Co., Louisville, Ky.

MacFarlane, G .... May, 1895
Cannel Coal Agent, Louisville, Ky.

Mather, Henry A .... May, 1894
Greenpoint Chemical Works, L. I.

McIlhenny, John .... May, 1884
Helme & McIlhenny, 1339 Cherry Street, Philadelphia, Pa.

Mansur, J. H .... May, 1895
President Keystone Meter Co., Royersford, Pa.

Marquis, P. S .... May, 1890
General Manager Ehret-Warren Manufacturing Co., St. Louis, Mo.

Mayer, J. F .... May, 1885
Constructing Engineer Bartlett, Hayward & Co., Baltimore, Md.

Milsted, W. N .... May, 1892
President and General Superintendent American Meter Co.,
New York, N. Y.

Morava, W .... May, 1892
Engineer and Contractor. Residence 5621 Monroe Avenue, Chicago, Ills.

Mordue, T. N .... May, 1895
Cannel Coal Agent, No. 1 Broadway, New York.

Moses, Frank D .... May, 1891
Superintendent Mutual Fuel Gas Co., Chicago, Ills.

Newman, William A .... May, 1889
Vice-President B. P. Clapp Ammonia Co., St. Louis, Mo.

Osius, George .... May, 1889
Secretary and Treasurer Michigan Ammonia Works, Detroit, Mich.

Page, A. I .... May, 1894
60 Wall Street, New York, N. Y.

Payne, F. H .... May, 1893
Secretary Metric Metal Co., Erie, Pa.

Persons, Fred. R .... May, 1885
With Standard Oil Co., 26 Broadway, New York, N. Y.

Prentice, A. T .... May, 1881
Agent R. D. Wood & Co., 42 Scott Street, Chicago, Ills.

Randle, C. H .... May, 1889
With Mutual Fuel Gas Co., Chicago, Ills.

Ranshaw, Henry .... May, 1883
President and Manager Stacey Mnfg. Co., Cincinnati, O.

Reed, Charles A .... May, 1890
President Chicago Retort and Fire Brick Co., 45th, Clark and LaSalle Street, Chicago, Ills.

Roots, Daniel T .... May, 1884
President P. H. & F. M. Roots Co., Connersville, Ind.

Roper, George D .... May, 1890
Manager Van Wie Gas Stove Co., Rockford, Ills.

Russell, Daniel R .... May, 1883
Vice-President Parker-Russell Mining and Mnfg. Co., St. Louis, Mo.

Russell, Thomas G .... September, 1878
Treasurer Parker-Russell Mining and Manfg. Co., St. Louis, Mo.

Sisson, Frank N .... May, 1886
Traveling Salesman D. McDonald & Co., Albany, N. Y.

Slocum, F. L .... May, 1895
President Gas Engineering Co., Pittsburgh, Pa.

Smallwood, James B .... May, 1883
Maryland Meter and Mnfg. Co., Baltimore, Md.

Smythe, A. E .... May, 1889
170 Broadway, N. Y.

Stacey, James B .... May, 1894
Care Stacey Manufacturing Co., Cincinnati, O.

Stacey, William .... May, 1882
Vice-President Stacey Manufacturing Co., Cincinnati, O.

Stout, John .... May, 1880
Agent American Meter Co., 125 and 127 South Clinton Street, Chicago, Ills.

Stratton, S. S .... May, 1887
Agent Metric Meter Co., Erie, Pa.

Taber, R. B .... May, 1892
With General Electric Co., 620 Atlantic Ave., Boston, Mass.

Tarvin, R. J .... May, 1885
Secretary and Treasurer Stacey Mfg. Co., Cincinnati, O.

Twining, E. H. B .... May, 1888
The Post Boynton Strong Co., 9-15 Illinois Street, Chicago, Ills.

Van Wie, P. G .... May, 1888
Manager Chicago Gas Stove Co., Chicago, Ills.

Van Wie, E. G .... May, 1893
With Chicago Gas Stove Co.

Waugh, F. K .... May, 1892
Agent J. J. Griffin & Co., Chicago, Ills.

Watson, W. P. . . . . May, 1892
Builder Gas Apparatus, 29 Broadway, N. Y.

Weber, Oscar B . . . . May, 1890
Manager Manhattan Fire Brick and Retort Works, 633 East Fifteenth Street, New York, N. Y.

Whirl, J. J. . . . . May, 1895
Agent Mason & Davis Gas Stoves, Chicago, Ills.

Wickham, Leigh . . . . May, 1892
Agent Parker-Russell Mining and Manufacturing Co., St. Louis, Mo.

Wilke, F. E . . . . May, 1894
Manufacturer Wilke China Kiln, Richmond, Ind.

Wilkin, John I . . . . May, 1894
Connersville Blower Co., Connersville, Ind.

Witherden, G. M . . . . May, 1892
Formerly with Metric Metal Co., Erie, Pa.

Woods, S . . . . May, 1895
Treasurer Gas Engineering Co., Pittsburgh, Pa.

Worcester, E . . . . May, 1885
Secretary Western Tube Co. Residence Chicago, Ills.

Worcester, Frank . . . . May, 1891
With National Tube Works Co., St. Louis, Mo.

Young, A. W . . . . May, 1884
Youghiougheny Gas Coal Co , Pittsburgh, Pa.

Honorary members	10
Active members	193
Associate members	89
Total	292

MEMBERS DECEASED.

Kerr Murray	Fort Wayne, Ind	May 6, 1880
*Thos. Butterworth	Rockford, Ill	April 5, 1885
Geo. E. Downing	New York City	1885
Alfred Odiorne	Reported at 1886 meeting. No date of death or city.	
T. E. Scobeg	“ 1886 “ “ “ “	
Jos. M. McClean	“ 1886 “ “ “ “	
*J. O. King	Jacksonville, Ills	April 16, 1887
N W. Jones		1887
J. M. Murphy	Baltimore, Md	Aug. 25, 1888
J. G. Miller	Green Bay, Wis	Mar. 2, 1889
Thos. Smith	Grand Rapids, Mich	Mar. 5, 1889
F. M. Roots	Connersville, Ind	Oct. 25, 1889
*E. J. King	Jacksonville, Ill	Oct. 28, 1889
*John Fullagar	San Jose, Cal	April 27, 1890
Theobald Forstall	Chicago, Ill	Jan. 19, 1890
S. H. Douglas	Ann Arbor, Mich	Aug. 26, 1890
Frank Beck	Galveston, Tex	Sept. 14, 1890
Enoch Veal	Booneville, Mo	Nov. 10, 1890
R. Woodmansee	Davenport, Ia	Dec. 5, 1890
W. H. Down	New York City	Feb. 15, 1891
E. M. Starr	Richmond, Ind	April 28, 1891
E. M. Russell	St. Louis, Mo	May 28, 1891
G. A. Hyde, Jr	Cleveland, Ohio	June 11, 1891
Edwin Lee Brown	Chicago, Ill	July 21, 1891
Samuel Pritchett	Nashville, Tenn	Sept. 21, 1891
Geo. Shepard Page	New York City	Mar. 26, 1892
G. A. McIlhenny	Washington, D. C	Oct. 16, 1892
J. J. Griffin	Philadelphia, Pa	Oct. 22, 1892
Geo. W. Ewing	E. St. Louis, Ill	Dec. 18, 1892
J. F. Rodgers	New Decatur, Ala	Dec. 31, 1892
H. S. Walbridge	Toledo, Ohio	Jan. 1, 1893
Peter E. DeMill, Jr	Detroit, Mich	June 27, 1893
Henry C. Felt	Cincinnati, Ohio	Jan. 10, 1895
Geo. H. Wells	Nashville, Tenn	Jan. 26, 1895

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*Past President.

CONSTITUTION AND BY-LAWS

OF THE

WESTERN GAS ASSOCIATION.

PREAMBLE.

WHEREAS, It is necessary that those to whom is intrusted the manufacture and sale of gas for illuminating and other purposes should endeavor, by every means within their power, to improve its quality to the highest, and reduce its cost to the lowest, practicable limit, thereby meeting the just expectation of both producer and consumer; and, believing that by united action only can results so desirable be accomplished, we do hereby ordain and establish this Constitution for the Western Gas Association.

CONSTITUTION.

ARTICLE I.

SECTION 1. Only officers and regular employees of gas companies shall be eligible for active membership.

SEC. 2. Any person who may be directly or indirectly connected with the gas industry, or who may be skilled therein, shall be eligible as an associate member of this Association. Such members shall be proposed, balloted for and received in the same manner, and be subject to the same fees and annual dues as active members, and shall be entitled to all the privileges and courtesies of the Association, except the right to vote or hold office.

SEC. 3. Election to membership shall be by ballot, and a three-fourths vote shall be necessary to elect.

ARTICLE II.

SECTION 1. The officers of the Association shall consist of a President, two Vice-Presidents, and a Secretary-Treasurer, who shall be elected for one year.

SEC. 2. There shall also be eight Directors, four of whom shall be elected at each annual meeting, and whose term of office shall be for two years; providing, that upon the adoption of this Constitution and By-Laws, the first Board elected thereunder shall be composed of eight members, four of whom shall be elected for one year, and four of whom shall be elected for two years.

SEC. 3. The retiring President shall be, ex-officio, a Director for the next following year; all other officers shall be elected by ballot.

SEC. 4. All officers shall retain their positions until their successors have qualified.

ARTICLE III.

SECTION 1. The management of the affairs of the Association shall be entrusted to the officers as a Board of Directors, under the general direction of the members in convention.

SEC. 2. A majority of the Board shall constitute a quorum, and the Board shall have power to fill any vacancies that may exist therein.

ARTICLE IV.

SECTION 1. Only active members shall vote or hold office, but no voting by proxy shall be allowed.

ARTICLE V.

SECTION 1. The Association shall have power to enact, amend and enforce all necessary by-laws and rules; to provide penalties for their violation; to assess and collect fees and dues for membership; and to provide a benefit fund for the relief of members and their families.

ARTICLE VI.

SECTION 1. Any proposition to amend this Constitution shall be submitted at a regular meeting, and seconded by a majority of all active members present; the proposition shall not be acted upon until the next regular meeting, when, if approved by two-thirds of all the active members who may be present at said meeting, it shall become a part of this Constitution.

BY-LAWS.

ARTICLE I.

ANNUAL MEETINGS.

The annual meeting of the Association shall be held on the third Wednesday in May of each year, at such place as shall be determined upon at the preceding annual meeting, at which time the election of officers shall take place and annual reports and settlements be made. At each annual meeting the President shall present an address, setting forth his official acts and such general items and recommendations as he may deem of advantage to the Association. All general business of the Association shall be transacted at these annual meetings, and the following shall be the order of business:

Calling the roll and reading of minutes.
President's address.
Presenting applications for membership and balloting.
Introduction of new members.
Reports of standing committees.
Reports of special committees.
Miscellaneous business, which may be laid aside informally and taken up at any time.
Special order for the presentation of papers, drawings or models, or other matters of interest to the Association entitled to consideration under its rules, in the discussion of which all the members shall be entitled to participate, and such special order may be considered at any time by vote of the Association.

ARTICLE II.

APPLICATION FOR MEMBERSHIP.

Any person desiring to become a member of this Association shall make his application in writing, giving name, residence and occupation, with proper references, and signed by two members of the Association; but no such application shall be acted upon until the fee for membership is paid.

ARTICLE III.

FEES AND DUES.

SECTION 1. The fee for membership shall be ten dollars, which shall include dues for the first year, and the yearly dues shall be five dollars, payable annually in advance thereafter.

SEC. 2. The Secretary shall drop from the roll the name of any member who shall be in arrears for two years dues, after giving thirty days notice.

SEC. 3. The Board of Directors shall have power to reinstate any member who, for non-payment of dues, has been suspended, or dropped from the roll, when such member shall have paid the full amount due at the time his membership ceased.

ARTICLE IV.

DUTIES OF OFFICERS.

SECTION 1. The President, or in the event of his absence, the Vice-Presidents, in their order, shall preside over meetings of the Association or of the Board of Directors. He shall enforce all laws and rules of the Association, and shall appoint all committees not otherwise provided for. He shall decide all questions of order, subject only to an appeal, but in all such cases it shall require at least a majority of the members present to overrule his decision. He shall sign the records and have general supervision of the affairs of the Association.

SEC. 2. The Secretary-Treasurer shall attend all meetings of the Association or of the Board of Directors, shall have charge of the books, papers and other property of the Association, and perform such other duties as may properly belong to his office.

ARTICLE V.

QUORUM.

A quorum for the transaction of business shall consist of not less than 15 members; but a smaller number may adjourn from day to day for not more than three days; and in case of the absence of the President or other proper officers they may select a Chairman to preside over the meeting.

ARTICLE VI.

BOARD OF DIRECTORS.

SECTION 1. The Board of Directors shall meet at least once in each year, on the day preceding the annual meeting of the Association, at which time they shall determine in regard to the propriety of the various papers, drawings, models or other matters constituting the special order being laid before the Association.

SEC. 2. When in the judgment of a majority of the Board of Directors it shall be deemed advisable to change the place or date of meeting, or both, as designated by the Association at its last annual meeting, the Board shall have power to make such change or changes.

SEC. 3. Said Board shall annually, immediately after its own organization, elect a Finance Committee of three from its own number, who shall have power to examine at any time the books and accounts of the Secretary-Treasurer; said committee shall also, on the morning of the first day of the annual meeting, examine the report of the Secretary-Treasurer, audit his accounts and report thereon to the Association; provided, that no officer whose accounts may be subject to examination shall, under any circumstances, be a member of such examining committee. The Board of Directors, at the same meeting, shall also appoint a committee of three from their own number, whose duty it shall be to examine and report on applications for membership.

SEC. 4. The Board of Directors shall also cause a record of its proceedings to be kept, which shall be submitted to the Association during the first day of the annual meeting.

ARTICLE VII.

EXECUTIVE COMMITTEE.

The President, the two Vice-Presidents and the Secretary-Treasurer shall constitute an Executive Committee, whose duty it shall be to meet at least once in each year, not less than 90 days before the annual meeting of the Association, for the purpose of choosing subjects and assigning authors for the papers, which shall be presented for the consideration of the Association at its next annual meeting.

ARTICLE VIII.

PAPERS, DRAWINGS, ETC.

All papers, drawings, models, etc., submitted to the Association at its annual meetings shall remain the property of those presenting the same.

ARTICLE IX.

REJECTED APPLICATIONS.

If any person proposed for membership shall, upon being balloted for, be rejected, no notice of such proposal shall be incorporated in the minutes.

ARTICLE X.

TRIALS AND PUNISHMENTS.

Any member may, upon conviction of violating any of the laws or rules of the Association, or of conduct unbecoming a gentleman, be suspended for a definite time, or expelled from the Association, by a vote of at least three-fourths of all the members present; provided, that any such accused member shall be furnished with a copy of the charges against him at least ten days before his trial, and be allowed an opportunity to appear either in person or by counsel for his defense.

ARTICLE XI.

RULES.

The business sessions of the Association shall be conducted in accordance with the requirements of Robert's Rules of Order.

ARTICLE XII.

SPECIAL MEETINGS.

Special meetings of this Association may be called by the President, by and with the written consent of a majority of the Board of Directors. He shall cause notices to be issued to all the members of the Association at least thirty days prior to such meetings; said notices to state the business for which such meeting has been called, and no other business than that mentioned in such notices shall be considered.

ARTICLE XIII.

AMENDMENTS.

These By-Laws may be altered or amended only in the following manner:

SECTION 1. Any proposition to alter or repeal an existing By-Law shall be presented in writing during an annual meeting, at any time before its adjournment, seconded by not less than three members, shall be read twice, and if approved by two-thirds of all the active members present, shall become a part of these By-Laws; but no such alteration or amendment shall affect any question pending at the time of its adoption.

SEC. 2. Any additional section to these By-Laws not in conflict with any existing By-Law, may be adopted at any annual meeting upon being presented in writing, duly seconded, read twice and approved by at least two-thirds of all the active members present.

To the Western Gas Association:

I, ... desire to become an .... member of your Association, and respectfully submit this application therefor.

Dated .... 190......

Name..

Residence...

Occupation...

We hereby approve and endorse the above application for .... Membership in the Western Gas Association.

.... } Members.

....

To the Western Gas Association:

I, ... desire to become an .... member of your Association, and respectfully submit this application therefor.

Dated .... 190 ...

Name ....

Residence ....

Occupation ....

We hereby approve and endorse the above application for .... Membership in the Western Gas Association.

....	Members.
....	

To the Western Gas Association:

I, ... desire to become an .... member of your Association, and respectfully submit this application therefor.

Dated .... 190.....

Name ....

Residence ....

Occupation ....

We hereby approve and endorse the above application for .... Membership in the Western Gas Association.

.... }
.... } Members.

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